

SOLUBILITIES

OF

INORGANIC AND METAL ORGANIC COMPOUNDS

A COMPILATION OF QUANTITATIVE SOLUBILITY
DATA FROM THE PERIODICAL
LITERATURE

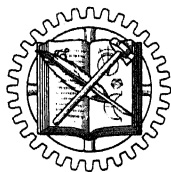
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SILVER BENZOATE

SOLUBILITY OF SILVER BENZOATE IN AQUEOUS SOLUTIONS OF SALTS AT 25°.
(Kolthoff and Bosch, 1932.)

Aq. Solution of:	Gm. Mols. per liter		Aq. Solution of:	Gm. Mols. per liter	
	Salt	Ag(C ₆ H ₅ COO)		Salt	Ag(C ₆ H ₅ COO)
KNO ₃	0.05	0.01298	Water alone	0.0	0.01162
"	0.09	0.01369	AgNO ₃	0.01	0.00786
"	0.10	0.01366	"	0.02	0.00576
"	0.25	0.01483	"	0.03	0.00447
"	0.50	0.01590	"	0.04	0.00392
NaNO ₃	0.50	0.01628	"	0.05	0.00328
LiNO ₃	0.50	0.01628	"	0.10	0.00248
Ba(NO ₃) ₂	0.50	0.01697	Na C ₆ H ₅ COO	0.01	0.00816
Mg(NO ₃) ₂	0.498	0.01759	"	0.02	0.00585
Sr(NO ₃) ₂	0.668	0.01784	"	0.03	0.00477
Ca(NO ₃) ₂	0.253	0.01633	"	0.04	0.00396
"	0.507	0.01834	"	0.05	0.00347
"	1.013	0.02079	"	0.10	0.00240

SILVER Chloro, Nitro, etc. BENZOATES.

SOLUBILITY OF EACH SEPARATELY IN WATER AT 20°.
(Ephraim and Pfister, 1925.)

Compound.	Formula.	Gms. anhydrous compound per 100 cc. sat. sol.	CH
Silver 4-Chloro Benzoate...	C ₆ H ₄ ClCOO Ag	0.108	
" 4-Methoxy " ...	C ₆ H ₄ .OCH ₃ .COO Ag	0.0518	
" 4-Nitro " ...	C ₆ H ₄ .NO ₂ .COO Ag	0.170	
" 4-Oxy " ...	C ₆ H ₄ .OH.COO Ag.3H ₂ O	0.272	

SILVER SALICYLATE C₆H₄.OH.COOA_g 1,2.

One liter sat. aqueous solution contains 0.95 gm. at 23°.
(Holleman, 1893.)

One liter sat. solution in H₂O contains 0.00332 gm. mols., equal to 0.813 gm. Ag C₆H₄.OH.CO O 1, 2 at 18°. (Kolthoff, 1926.)

SILVER HEPTOATE (Önanthylate) AgC₇H₁₃O₂.

SOLUBILITY IN WATER.
(Landau, 1893; Altschul, 1896.)

t°.	Gms. AgC ₇ H ₁₃ O ₂ per 100 Gms. H ₂ O.		t°.	Gms. AgC ₇ H ₁₃ O ₂ per 100 Gms. H ₂ O.	
0	0.0635 (Landau)	0.0436 (Altschul)	50	0.1652 (Landau)	0.0858 (Altschul)
10	0.0817	0.0494	60	0.1906	0.1036
20	0.1007	0.0555	70	0.2185	0.1351
30	0.1206	0.0617	80	0.2495	0.1688
40	0.1420	0.0714			

SILVER CINNAMATE C₆H₅.CH:CHCOOA_g.

100 gms. sat. solution of silver cinnamate in water contain 0.012 gms. C₆H₅.CH:CH COOA_g at 20°.
(Ephraim and Pfister, 1925.)

SILVER α NAPHTHOATE $\text{Ag}[\text{C}_{10}\text{H}_7\text{COO}]$

One liter H_2O dissolves 1.67 gm. $\text{Ag}[\text{C}_{10}\text{H}_7\text{COO}]$ at 25° . (Larsson, 1927.)

SILVER SULFONATES.

SOLUBILITY OF EACH SEPARATELY IN WATER. (Ephraim and Pfister, 1925a.)

Compound.	Formula.	t°.	Gms. anhydrous compound per 100 cc. sat. sol.
Silver anthracene-1-sulfonate.....	$\text{AgC}_{14}\text{H}_9\text{SO}_3$	20	0.059
" " -2- "	"	20	0.0318
" naphthalene-2- "	$\text{AgC}_{10}\text{H}_7\text{SO}_3$	16.5	1.716
" " -5-chlor-1-sulfonate..	$\text{AgC}_{10}\text{H}_6\text{SO}_3\text{Cl}$	20	0.551
" phenanthrene-2-sulfonate	$\text{AgC}_{14}\text{H}_9\text{SO}_3$	20	0.099
" " -3- "	"	20	0.20
" " -10- "	"	20	0.52

SILVER HELIANTHATE $\text{C}_{14}\text{H}_{14}\text{N}_3\text{SO}_3\text{Ag} \cdot 2\text{H}_2\text{O}$.

1000 cc. H_2O dissolve 0.292 gm. $\text{C}_{14}\text{H}_{14}\text{N}_3\text{SO}_3\text{Ag} \cdot 2\text{H}_2\text{O}$ at $20-25^\circ$.
(Stark and Dehn, 1918.)

SILVER PALMITATE $\text{CH}_3(\text{CH}_2)_{14}\text{COOAg}$.

1000 cc. sat. solution of silver palmitate in water contain 0.00123 gm. $\text{C}_{15}\text{H}_{31}\text{COOAg}$ at 20° . (Whitby, 1926.)

SILVER STEARATE $\text{CH}_3(\text{CH}_2)_{16}\text{COOAg}$.

1000 cc. sat. solution of silver stearate in water contain 0.00065 gm. $\text{C}_{17}\text{H}_{35}\text{COOAg}$ at 20° . (Whitby, 1926.)

SILVER LAURATE, MYRISTATE, PALMITATE and STEARATE

SOLUBILITY OF EACH, DETERMINED SEPARATELY, IN WATER AND OTHER SOLVENTS AT SEVERAL TEMPERATURES.

(Jacobson and Holmes, 1916.)

Solvent.	t°.	Gms. each Salt per 100 Gms. Solvent.			
		Laurate.	Myristate.	Palmitate.	Stearate.
Water	35	...	0.007	0.004	0.004
"	50	...	0.007	0.006	0.004
Abs. Ethyl Alcohol	25	0.009	0.008	0.007	0.007
" "	50	0.009	0.008	0.007	0.007
Methyl Alcohol	15	0.074	0.063	0.060	0.051
" "	25	0.072	0.067	0.059	0.052
" "	35	0.078	0.071	0.062	0.055
" "	50	0.083	0.073	0.066	0.060
Ether	15	0.010	0.009	0.009	0.007

CN SILVER CYANIDE AgCN **SOLUBILITY OF SILVER CYANIDE IN WATER**

t°	Mols. AgCN per liter	Gms. AgCN per liter	Method	Authority
17.5	3.17×10^{-7}	0.000042	Conductivity	(Abegg and Cox, 1903.)
18.0	2.10×10^{-7}	0.000028	Potentiometric	(Masaki, 1930.)
20.0	1.64×10^{-6}	0.00022	Conductivity	(Bottger, 1903.)

SILVER CYANIDE AgCN.**SOLUBILITY OF SILVER CYANIDE IN AQUEOUS AMMONIA SOLUTIONS.**

(Longi, 1883.)

100 gms. aq. ammonia of 0.998 Sp. Gr. = 5%, dissolve 0.232 gm. AgCN at 12°.

100 gms. aq. ammonia of 0.96 Sp. Gr. = 10%, dissolve 0.542 gm. AgCN at 18°.

One liter aq. 3 *N* AgNO₃ dissolves 0.0091 gm. mol. = 1.216 gm. AgCN at 25°.
(Hellwig, 1900.)

Fusion-point data for mixtures of AgCN + NaCN are given by Truthe (1912).

SOLUBILITY OF SILVER CYANIDE IN AQUEOUS SOLUTIONS OF HYDROCYANIC ACID AT 25°.

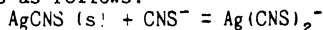
(Randall and Halford, 1930.)

This system was studied by the authors as a case of equilibrium in a chemical reaction involving the formation of a complex ion. The saturation equilibrium is, therefore, not that of a simple solution. A small concentration of strong acid is produced, but the amount is so small that an accurate determination of the equilibrium constant is difficult. The assumed reaction is $\text{Ag}(\text{CN})_2(\text{s}) + \text{HCN}(\text{aq.}) = \text{H}^+ + \text{Ag}(\text{CN})_2^-$. The measurements are expressed in terms of molalities.

$m(\text{HCN}(\text{aq.}))$	$m(\text{HAg}(\text{CN})_2)$	$m(\text{HCN}(\text{aq.}))$	$m(\text{HAg}(\text{CN})_2)$
0.0296	0.000983	0.2275	0.00424
0.1016	0.00204	0.2325	0.00315
0.1596	0.00245	0.3000	0.00375
0.1780	0.00366	0.3625	0.00331
0.1825	0.00246	0.4230	0.00400
0.2124	0.00292	0.4260	0.00511
0.2245	0.00272	0.4465	0.00427

CN

Similar determinations of the solubility of Silver Thiocyanate in aqueous solutions of Potassium Thiocyanate at 25° and the assumed reaction which occurs, is as follows.



Original $m(\text{KCNS})$	$m(\text{AgCNS})$	$m(\text{KCNS}(\text{free}))$
0.312	0.00202	0.310
0.564	0.0121	0.512
0.870	0.0458	0.824
1.124	0.0985	1.026

These results cannot be accounted for by the formation of the single complex ion $\text{Ag}(\text{CNS})_2^-$

SOLUBILITY OF SILVER CYANIDE IN AQUEOUS SOLUTIONS
OF POTASSIUM CYANIDE AT 25° AND VICE VERSA.

(Bassett and Corbet. 1924.)

Gms. per 100 gms. sat. sol.		Solid. Phase.	Gms per 100 gms sat. sol.		Solid. Phase.
KCN.	AgCN.		KCN.	AgCN.	
41.7	0.00	KCN	20.14	21.66	KAg(CN) ₂
40.77	6.52	»	8.56	16.11	»
39.91	8.14	»	8.05	15.76	KAg ₂ (CN) ₃ ·H ₂ O
40.24	10.93	»	8.93	17.73	»
40.44	13.71	K ₃ Ag(CN) ₄ ·H ₂ O	6.75	13.53	AgCN
37.76	18.92	»	2.36	4.42	»
35.19	25.18	»	1.64	3.27	»
28.43	26.37	KAg(CN) ₂	1.26	2.31	»
26.67	24.71	»	2.16	trace	»

Note. Due to the difficulty of obtaining KCN free of KOH the saturated solutions were prepared from double salts which could be obtained free of KOH. Saturation was reached by constant rotation in wax bottles, in which an atmosphere of coal gas, washed by passing through solutions of lead acetate and sodium hydroxide, was maintained. Both the liquid and solid phases were analyzed.

100 gms. liquid SO₂ dissolve 0.019 gm. AgCN at 0°. (Jander and Ruppolt, 1937.)

CN

SILVER DICYANIMIDE AgN(CN)₂

One liter saturated solution in water contains 0.0064 gm. AgN(CN)₂ at 18°-20°, determined by the potentiometric method. (Birchenbach and Huttner, 1930.)

SILVER TRICYAN METHYL AgN(CN)₃

One liter saturate solution in water contains 0.013 gm. AgN(CN)₃ at 18°-20°, determined by the potentiometric method. (Birchenbach and Huttner, 1930.)

SILVER FERRICYANIDE Ag₃FeCN₆.

One liter H₂O dissolves 0.00066 gm. Ag₃FeCN₆ at 20°.

(Whitby, 1910.)

SILVER SODIUM CYANIDE AgCN.NaCN.

100 gms. H₂O dissolve 20 gms. at 20°, and more at a higher temperature. 100 gms. 85% alcohol dissolve 4.1 gms. at 20°.

(Baup, 1858.)

SILVER THALLOUS CYANIDE AgCN.TlCN.

100 gms. H₂O dissolve 4.7 gms. at 0°, and 7.4 gms. at 16°.

(Fronmüller, 1878.)

PREFACE

The first edition of this compilation, comprising 353 pages, appeared in 1907. A completely revised second edition, containing 756 pages of tables, was published in 1919. Due to the high cost of printing tables, the new material collected after 1919 could not be economically combined with that already published, and was issued in 1928 as a supplementary volume of 500 pages. This plan cannot be repeated, since the searching of desired data in a series of three volumes would be awkward. Therefore a complete revision of the compilation has become necessary.

The cost of printing by the usual method has not declined and the amount of new data to be added has continued to increase. Consequently, the publication of a completely revised edition would not have been possible except by taking advantage of the economical process of off-set printing, and the new developments in the microfilm copying of printed pages. The present compilation is accordingly, an example of the type of compendia of experimental research which these two applications of photography have made possible.

Due to the very large amount of quantitative solubility data which is now available, its publication in a single volume of convenient size is no longer possible. Therefore, it has been decided to include all data upon inorganic and metal organic compounds in one volume, and the results upon the compounds of carbon in a second volume.

Advantage has also been taken of this circumstance to change the manner of arranging the data. The alphabetical plan based on the English names of the compounds has been changed to one having the symbols of the elements as the basis for the alphabetical arrangement. This purely chemical system of presenting the data will be more convenient to chemists having an imperfect knowledge of English, and in addition, makes it possible to use the symbols as guiding marks for locating desired results. For this purpose the symbols of the basic constituents of the inorganic compounds are placed at the upper outer corner of the pages, and those identifying the acidic constituent, and thus the particular compound in each case, are placed lower down on the outer margins of the pages.

In accordance with the principle adopted for previous editions, the results for systems of two or more compounds are always entered under that one of which the initial letter of its formula comes first in the alphabet. This has the effect of causing the larger amount of the data to be placed under the first letters of the alphabet. With this single rule in mind it should always be possible to find results for particular systems, but not always for each separate compound of which they are composed. In order to provide for those cases in which results are given in other than the expected alphabetical position, a formula index, serving the purpose of cross references, is given at the end of this volume.

The procedure by which the new material has been collected differs from that previously followed in that, thanks to microfilm copying, it has no longer been necessary to manually transcribe from each original paper the data to be subsequently used. It has simply been necessary to note the papers found by perusing the periodicals, and have these photographically copied on microfilm. These microfilm copies then become the source material from which the compilation is made. This not only effects a saving in the effort required to collect the original data but reduces by one-half the errors due to copying.

When microfilm copies of all papers published since 1927 had been collected, the formulae of the compounds for which results were given in each case, were written on a sheet of paper to which the microfilm copy was attached. With the aid of these notations the new results could be alphabetically assembled with those taken from the preceding volumes. Thus all available results upon each compound or system were brought together for comparison and selection of the final values to be included in the new book. The actual compilation could then be made without further recourse to the periodical collections in libraries, and under conditions particularly favorable for the orderly arrangement and accurate presentation of the data.

In reference to the manner in which the pages of the new book have been prepared for planographic reproduction, it is necessary to call attention to certain imperfections which have resulted. Since these pages are composed of tables reproduced from the volume printed in 1918, in the United States, and the supplementary volume printed in 1927, in France, together with the tables of new data typewritten on a "Varityper" and photographically reduced, a considerable variety of type size and design has resulted. This variation in typography is to be regretted but the expense of completely resetting the book would have prevented its publication.

In addition to the typographical variations, a perceptible reduction in sharpness of definition of the print will be noted in some cases. This results from the two fold photographic reproduction of the new tables, and the slight imperfection of some of the old pages. It is hoped that these deficiencies in uniformity, and occasional indistinctness of the typography will not diminish the value of the compilation to those having need of it in their work. This plan of combining the previously collected data with the new, has made it possible to prepare a more nearly complete collection of solubility data, at a far less expense, than would have been possible by the usual methods of printed publication.

Another point about which a word of explanation should be given is the variation in nomenclature resulting from the use of the latin names, such as argentum, aurum, kalium, natrium, plumbum, etc., from which the symbols used in the alphabetical arrangement, were derived. In these cases, the cost of changing the English names in the titles of the tables reused from

the previous edition. did not appear warranted. Furthermore, it is recognized that in spite of the advantage of the adoption of the latin names, in rendering the language of chemistry more universal, there are many persons who prefer correctness of expression in their own language, to the more general and precise comprehension of the chemical information imparted. Although the English names are retained in the majority of cases, it is hoped that eventually an international system of naming chemical compounds will be developed. This would make the names of the substances with which chemists are concerned, as universal as the chemical symbols of which they are composed.

The general practice observed in previous editions of this compilation. with respect to limitations of scope and orderly presentations of the numerical results has been followed in the present one. Since the name alone does not always accurately identify a compound, greater precision has been sought by giving the chemical formula as well. In a few cases, however, due to lack of information in the original papers this could not be done. It should be mentioned also that occasionally the original results are presented in terms which are not accurately defined. Considering the effort involved in the quantitative determination of solubilities, it is regrettable that authors sometimes fail to mention details essential to the precise comprehension of their work.

The brief remarks in connection with some of the tables are intended to indicate the general character of the experiments, the methods used, and the probable accuracy of the results. The absence of such remarks may be taken to mean that the determinations presented no exceptional difficulties, that they were made by the usual methods, and with acceptable care. For those cases where incomplete results are given or more information than is quoted in the present compilation is desired, a microfilm copy of the original paper may be obtained, at very little expense, by sending the exact reference to Bibliofilm Service, in care of the Library, U. S. Department of Agriculture Washington, D. C.

In conclusion, I wish to thank those who have called my attention to errors in the previous editions, and mention that I will be equally grateful to those who take the trouble to notify me of mistakes in the present volume.

I am greatly indebted to Mr. Leslie J. Robinson for the painstaking manner in which he has made the Varitype copies of all new tables, and to Mr. John R. Van Cott for combining these with the tables reused from the previous volumes in the final form here shown.

A. S.

Washington, D. C., March 30, 1940.

ABBREVIATIONS

Most of the following abbreviations will be found written both with capitals and without.

- [α].D. — Specific Rotation.
- abs. — Absolute.
- abs. coef. — Absorption Coefficient.
- alcohol. — Ethyl Alcohol.
- amt(s). — Amount(s).
- anhy. — Anhydrous.
- aq. — Aqueous.
- atm(s). — Atmosphere(s).
- at. wt. — Atomic Weight.
- b.-pt. — Boiling-point.
- C. — Centigrade.
- calc. — Calculate(ed).
- cc. — Cubic Centimeter(s).
- cm. — Centimeter(s).
- coef. — Coefficient.
- com. — Commercial.
- compd. — Compound.
- conc. — Concentration, Concentrated.
- cond. — Conductivity.
- const. — Constant.
- cor. — Corrected.
- crit. — Critical.
- cryo. — Cryohydric.
- cryst. — Crystalline.
- d. — Dextro (in connection with the name of an optically active compound).
- d. — Density (d_{18} — Specific Gravity at 18°, referred to water at 4°; d_{20}^{20} at 20° referred to water at 20°).
- decomp. — Decomposition.
- dif. — Different.
- dil. — Dilute.
- dist. coef. — Distribution Coefficient.
- ed. — Edition.
- elec. — Electric(al).
- equil. — Equilibrium.
- equiv. — Equivalent(s).
- eutec. — Eutectic.
- F. — Fahrenheit.
- f.-pt. — Freezing-point.
- g., gm., gms. — Gram(s).
- gm. mol. — Gram Molecule(s).
- G. M. — Gram Molecule(s).
- hr(s). — Hour(s).
- i. — ($d + l$) Inactive (in connection with the name of an optically active compound.)
- inorg. — Inorganic.
- insol. — Insoluble.
- l. — Lævo (in connection with the name of an optically active compound).
- kg. kgm. — Kilogram(s).
- l. — Liter(s).
- mm. — Millimeter(s).
- m. — Meta.
- max. — Maximum.
- mg., mgm. — Milligram(s).
- mol(s). — Molecule(s), Molecular.
- mol. wt. — Molecular Weight.
- millimol. — Milligram Molecule.
- m.-pt. — Melting-point.
- n. — Normal (gm. equiv. per l.).
- N. — Normal (used rarely).
- o. — Ortho.
- ord. — Ordinary.
- org. — Organic.
- p. — Page.
- p. — Para.
- pet. — Petroleum.
- ppt. — Precipitate.
- pt. — Point.
- quad. pt. — Quadruple Point.
- qual. — Qualitative.
- sapon. — Saponification.
- sat. — Saturated.
- sol(s). — Solution(s).
- sp. gr. — Specific Gravity (Density).
- sq. cm. — Square Centimeter.
- s. — Symmetrical.
- sym. — Symmetrical.
- ° — Temperature, Centigrade Scale.
- temp(s). — Temperature(s).
- tr. pt. — Transition Point.
- vol(s). — Volume(s).
- undissoc. — Undissociated.
- U. S. P. — U. S. Pharmacopœia.
- wt. — Weight.
- ∞ — Infinity.
- 10^{-2} , 10^{-5} , etc., following a result means that the decimal point is to be moved as many places to the left as indicated by the minus exponent.

SOLUBILITY OF ARGON IN WATER
(Lannung, 1930; Von Antropoff, 1919.)

t°	Lannung		Von Antropoff
	a	1	B
0	0.0560	—	0.0580
5	0.0460	0 —	0.0500
10	0.0405	0.0425	0.0450
15	0.0365	0.0391	0.0408
20	0.0336	0.0361	0.0374
25	0.0310	0.0342	0.0350
30	0.0288	0.0321	0.0327
35	0.0270	0.0305	0.0305
40	0.0252	0.0290	0.0286
45	0.0237	0.0278	0.0270
50	0.0223	—	0.0257

a = Bunsen Absorption Coefficient which shows the volume of gas (at 0° and 760 mm. Hg. pressure) dissolved by one volume of solvent at the given temperature when the partial pressure of the gas is 760 mm. Hg.

1 = Ostwald Partition Coefficient which is the equilibrium distribution ratio of the volume concentrations of the gas in the solution and in the vapor phase. The relation between 1 and a is, $1 = aT/273$ where T is the absolute temperature at which the measurement was made.

B = Kuenen's modification of the Bunsen Absorption Coefficient in which one gram of solvent is substituted for one cubic centimeter of solvent.

The results in the above table were read from curves plotted from the data given by Lannung and von Antropoff. In both cases the determinations were made with great care. Lannung points out that the previous measurements of Estreicher, 1899 are uncertain on account of the small volume of gas, the large amount of dead space in his apparatus and the difficulty of measuring the volume of gas in the dry state.

SOLUBILITY OF ARGON IN SEVERAL SOLVENTS
(Lannung 1930.)

t°	Methyl Alcohol CH_3OH		Ethyl Alcohol $\text{C}_2\text{H}_5\text{OH}$		Acetone $(\text{CH}_3)_2\text{CO}$	
	a	1	a	1	a	1
15	0.253	0.267	0.243	0.256	0.271	0.286
18	0.251	0.267	0.242	0.258	0.271	0.290
20	0.250	0.268	0.240	0.258	0.273	0.293
25	0.245	0.267	0.237	0.258	0.274	0.299
30	0.243	0.270	0.234	0.260	0.276	0.306
37	0.240	0.273	0.231	0.262	0.279	0.317

t°	Benzene C_6H_6		Cyclohexane $\text{CH}_2(\text{CH}_2\text{CH}_2)_2\text{CH}_2$		Cyclohexanol $(\text{CH}_2)_5\text{CHOH}$	
	a	1	a	1	a	1
15	0.220	0.232	0.308	0.325	—	—
18	0.221	0.236	0.307	0.327	—	—
20	0.221	0.237	0.306	0.328	—	—
25	0.222	0.242	0.305	0.333	0.112	0.112
30	0.222	0.246	0.304	0.337	0.113	0.125
37	0.222	0.252	0.303	0.344	0.114	0.129

SOLUBILITY OF ARGON IN WATER AND IN
SEVERAL SOLVENTS AT HIGH PRESSURES
(Sliskind and Kasarnowski, 1931, 1933.)

A steel bomb of about 100 cc. capacity, as described by Ipatiew, Jr., Drusking-Artemowitsch and Tichomirow, 1932, was used.

Solvent	t°	Pressure in Atmospheres P	cc. A per 1 cc. Solvent at Pressure P W ₀	Corrected W ₀	Calc. Bunsen Absorp. Coef. a
H ₂ O	+0.2	1	0.0515	0.0515	0.0515
"	"	25	1.25	1.29	0.0516
"	"	50	2.46	2.52	0.0504
"	"	75	3.43	3.50	0.0467
"	"	100	4.27	4.35	0.0435
CH ₃ OH	"	125	4.95	5.06	0.0405
"	"	1	0.262	0.262	0.262
"	"	25	7.56	7.76	0.310
"	"	50	15.8	16.2	0.325
"	"	75	23.2	23.8	0.317
"	"	100	30.1	30.9	0.309
C ₂ H ₅ OH	"	1	0.251	0.251	0.251
"	"	25	7.39	7.57	0.303
"	"	50	15.4	15.8	0.315
"	"	75	22.3	22.8	0.304
"	"	100	26.9	27.5	0.275
(C ₂ H ₅) ₂ O	0	25	13.8	—	0.554
(CH ₃) ₂ CO	"	25	9.31	—	0.238
CH ₃ (CH ₂) ₃ CH ₃	"	25	33.0	—	1.32
C ₆ H ₅ CHO	"	25	2.67	—	0.106

Data for the solubility of Argon in distilled water and in sea water, together with a critical discussion of the literature, are given by Coste, 1917.

One liter of cyclohexanol dissolves 171.21 cc. Argon at 26° and 755 mm Hg. pressure (Cauquil, 1927.).

SOLUBILITY OF ARGON IN AQUEOUS SALT SOLUTIONS AT 25°
(Åkerlöf, 1935.)

Salt	Mols Salt per 1000 gms. H ₂ O	a	Salt	Mols Salt per 1000 gms. H ₂ O	a
None	=H ₂ O	0.0332	CaCl ₂	2.95	0.0216
KCl	3.00	0.0220	"	5.37	0.0180
"	4.55	0.0174	SrCl ₂	2.10	0.0203
NaCl	3.23	0.0216	"	3.56	0.0150
"	5.98	0.0149	BaCl ₂	1.25	0.0185
LiCl	3.35	0.0248	"	1.74	0.0141
"	6.78	0.0187	MgCl ₂	3.02	0.0248
NaNO ₃	3.51	0.0204	"	5.02	0.0228
"	7.37	0.0123	AlCl ₃	0.98	0.0247
HClO ₄	4.05	0.0411	"	0.56	0.0179
"	9.32	0.0521			

Data for the solubility and diffusion of argon in solid and liquid metals are given by Sieverts and Bergner, 1912.

Palladium, activated by thermic treatment in a vacuum absorbs 319 volumes of argon, Klarman, 1930

SOLUBILITY OF ARGON IN SEVERAL SOLVENTS AT HIGH PRESSURES

(Sisskind and Kasarnowski, 1931, 1933.)

Solvent	t°	Pressure in Atmospheres	Calc. Bunsen Absorp. Coef. a	Solvent	t°	Pressure in Atmospheres	Calc. Bunsen Absorp. Coef. a
Acetone	0	50	0.249	Diethyl Ketone	0	50	0.237
"	0	100	0.254	Methyl Hexyl Ketone	0	50	0.193
n Propyl Alcohol	0	50	0.220	Ethyl Propyl Ketone	0	50	0.238
n Butyl Alcohol	0	50	0.209	Cyclohexanon	0	50	0.127
Iso Butyl Alcohol	0	50	0.228	"	0	100	0.128
Sec. Butyl Alcohol	0	50	0.210	"	25	50	0.124
Iso Amyl Alcohol	0	25	0.210	Benzene	7	50	0.197
Iso Amyl Alcohol	0	50	0.210	"	7	100	0.203
n Hexyl Alcohol	0	25	0.174 (0.190)	"	7	125	0.204
n Octyl Alcohol	0	50	0.163	Toluene	0	25	0.200
Sec. Octyl Alcohol	0	25	0.172	"	0	50	0.200
Benzyl Alcohol	0	25	0.060	"	0	75	0.214
Benzyl Alcohol	0	50	0.060	"	7	50	0.195
Cyclohexanol	25	50	0.112	Xylene	0	50	0.196 (0.205)
Methyl Ethyl Ketone	0	25	0.222 (0.239)	"	0	100	0.211
Methyl Propyl Ketone	0	50	0.234	Cyclohexane	25	50	0.302
				Methyl Cyclohexane	25	50	0.311
				Benzyl Ether	0	25	0.068
				" "	0	50	0.069
				" "	0	100	0.072

ACTINIUM EMANATIONS.

SOLUBILITY IN SEVERAL SOLVENTS.

(Hevesy, 1912.)

A method was elaborated for determining the partition coefficient between a gas and a liquid phase. The solubility of actinium emanations was then determined in KCl, H₂O, H₂SO₄, C₂H₅OH, C₆H₁₁OH, (CH₃)₂CO, C₆H₅CHO, C₆H₆, C₇H₈, petroleum ether and CS₂. The solubility increases in the order named. Close relations are indicated between actinium, thorium and radium.

Experiments are described by Imre, 1927, upon the separation of RaAc by means of distribution studies. Since iron can be removed from its hydrochloric acid solution by extraction with ether, this principle was applied to the separation of RaAc. Nitric acid was substituted for hydrochloric acid. Results are given for the extraction of aqueous nitric acid solutions of thorium by means of ether, and similar results for nitric acid actinium solutions. This method failed to separate RaAc into two components, thus furnishing new evidence of its unity.

ARGENTUM

4

ARGENTUM

SILVER, Ag:

SOLUBILITY OF SILVER IN WATER

(Křepelka and Toul, 1923)

Silver of purity sufficient for atomic weight work was employed. Thin leaves of it were placed in contact with highly purified and freshly distilled water in completely filled and tightly stoppered Erlenmeyer flasks, on the one hand and in silver flasks on the other. The flasks thus prepared were kept in the dark at 18°-20°C. and shaken from time to time.

For analysis the water from the vessels was poured into a quartz dish and carefully evaporated in the dark to 60-80 cc. The Ag in this solution was determined by nephelometric comparisons with known standards. Maximum solubility was reached in 21 days and corresponded to

0.035 mg. Ag. per 1000 cc. water.

Silver sheets, the surface of which had been previously reduced by pure dry hydrogen at 400° showed no solubility as measured by nephelometric tests. Hence it follows that the dissolution of silver is caused by its surface oxide, or by oxygen on its surface or dissolved in the water. Measurements made in glass vessels were, on the average 0.003 mg. higher than those made in silver vessels. This difference is probably due to the influence of alkalis dissolved from the glass.

Determinations of the solubility of silver in distilled water are also given by Freudlich and Söllner, 1928. Using 40 sq. cm. of silver surface per 100 cc. of water and a contact period of 3 days, 0.025 mg. Ag per liter were found. The analyses were made by Haber et al, 1926, microcoulometric method.

THE SOLUBILITY OF SILVER IN MERCURY

(Sunier and Hess, 1928; De Right, 1933.)

Highly purified Hg and excess of pure Ag were agitated together by gentle rocking in an evacuated tube provided with a side bulb into which the saturated solution could be filtered through glass wool by inverting and allowing air to enter the apparatus. Equilibrium was approached from both sides at each temperature. The analyses were made by distilling the mercury from the filtered saturated solution at 200° under vacuum or by volatilizing it in a stream of Hydrogen at 270°-300°, and weighing the residual silver. The results are expressed in terms of gram atoms of Ag per 100 gram atoms of Ag + Hg. The authors discuss previous published determinations.

t°	Atomic Percent Ag	t°	Atomic Percent Ag	t°	Atomic Percent Ag
10	0.048	60	0.190	120	0.587
20	0.066	70	0.241	140	0.797
30	0.088	80	0.288	160	1.053
40	0.114	90	0.352	180	1.356
50	0.147	100	0.419	200	1.708

For equilibrium between metallic Silver and mercury (Silver amalgam) and mixed aqueous solutions of their nitrates, determined for mixtures of the two metals in all proportions, see Reinders, 1906.

Results for the solubility of Ag in Cu, determined by hardness measurements are given by Hansen, 1930; and determinations by the X ray method are given by Agnew and Sacks, 1930.

Data for the distribution of silver between Zn + Pb, Zn + Bi, Al + Pb, Al + Bi, Zn + Tl and Al + Tl are given by Tammann and Schaftmeister, 1924.

Data for the equilibrium between melted silver and the chlorides of Cu and Pb are given by Tubandt and Munzing, 1927.

SILVER ARSENATE Ag_3AsO_4 .

One liter H_2O dissolves 0.0085 gm. Ag_3AsO_4 at 20° . (Whitby, 1910.)

SILVER ARSENITE Ag_3AsO_3 .

One liter H_2O dissolves 0.0115 gm. Ag_3AsO_3 at 20° . (Whitby, 1910.)

The determinations of Whitby were made by a colorimetric method which was based upon the observation that the color produced by heating a solution of a silver salt with sodium hydroxide and certain organic compounds such as dextrine, starch, sugar etc., is proportional to the amount of silver present.

SILVER BORATE AgBO_2 .

One liter of aqueous solution contains about 9.05 gms. AgBO_2 at 25° .
(Abegg and Cox, 1903.)

SILVER DIBORATE $\text{Ag}_2\text{O} \cdot 2\text{B}_2\text{O}_3 \cdot 2\text{H}_2\text{O}$

The System $\text{Ag}_2\text{O} + \text{B}_2\text{O}_3 + \text{H}_2\text{O}$ at 19°
(Rollet, 1930)

Gms. per 100 gms. Sat. Solution		Solid Phase	Gms. per 100 gms. Sat. Solution		Solid Phase
Ag_2O	B_2O_3		Ag_2O	B_2O_3	
0.16	0.1	$\text{Ag}_2\text{O} \cdot 2\text{B}_2\text{O}_3 \cdot 2\text{H}_2\text{O}$	0.91	3.51	$\text{Ag}_2\text{O} \cdot 2\text{B}_2\text{O}_3 \cdot 2\text{H}_2\text{O} + \text{B}(\text{OH})_3$
0.22	0.75	"	0.70	3.3	$\text{B}(\text{OH})_3$
0.33	1.4	"	0.35	2.9	"
0.55	2.2	"	0.0	2.6	

SILVER Tri Antipyrine BORO FLUORIDE $\text{Ag}(\text{COC}_{10}\text{H}_{12}\text{N}_2)_3 \text{BF}_4$

100 cc sat. solution in H_2O contain 17.7 gms. salt at 20° .
(Wilke-Dorffurt and Mureck, 1929)

SILVER BROMIDE AgBr .

SOLUBILITY IN WATER.

t°	Gms. AgBr per Liter.	Authority
18(?)	0.00029	(Hahn and Schulze, 1927.)
18	0.00012	(Kolthoff, 1921.)
18	0.000131	(Masaki, 1930.)
20	0.000084	(Böttger—Z. physik. Ch. 46, 602, '03.)
25	0.000137	(Abegg and Cox—Z. physik. Ch. 46, 11, '03.)
100	0.00370	(Böttger—Z. physik. Ch. 56, 93, '06.)

(See also Holleman — Z. physik. Ch. 12, 129, '93; Kohlrausch — *Ibid.* 50, 365, '05.)

SOLUBILITY OF SILVER BROMIDE IN WATER AND IN AQUEOUS SOLUTIONS OF ACIDS AND SALTS.

(Bedell, 1938.)

The method (see Bedell, 1937) consisted in alternately adding, drop-wise, 0.001 normal solutions of silver hydroxide and hydrobromic acid to 100cc of water at the chosen temperatures. The point at which a precipitate appeared was determined by observing the diffraction of a beam of light passing through the solution.

t°	Gms. AgBr per liter sat. sol.
20	0.00035
40	0.00066
60	0.00112
80	0.00184

Using the above method, but substituting 0.001 normal silver nitrate or silver sulfate for the hydroxide and various bromides for the hydrobromic acid, the author obtained results, at about 20°, for the solubility of silver bromide in aqueous solutions of KNO_3 , LiNO_3 , $\text{Ba}(\text{NO}_3)_2$, $\text{Mn}(\text{NO}_3)_2$, HNO_3 , H_2SO_4 , $\text{Hg}(\text{NO}_3)_2$ and HgSO_4 , varying in concentration between 0.0004 and 0.0252 gms. per liter. The results showed that with the exception of mercuric nitrate and sulfate only a very slight increase in solubility of the AgBr occurred. The increase in solubility with the mercury salts confirms the previously reported existence of compound formation, between silver bromide & mercury salts.

Br

SOLUBILITY OF SILVER BROMIDE IN AQUEOUS AMMONIA SOLUTIONS.

(Longi — Gazz. chim. ital. 13, 87, '83; at 80°, Pohl — Sitzber. Akad. Wiss. Wien, 41, 267, '60.)

Solvent.	Gms. AgBr at 12° per		Gms. AgBr at 80° per 1000 Gms. Solvent.
	1000 cc. Solvent.	1000 Gms. Solvent.	
Ammonia Sp. Gr. 0.998 = 5%	0.114	0.114	...
Ammonia Sp. Gr. 0.96 = 10%	3.33-4.0	3.47	...
Ammonia Sp. Gr. 0.986	...	...	0.51* 1.0†

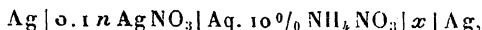
* Dried AgBr.

† Freshly pptd.

SOLUBILITY IN AQUEOUS SOLUTIONS OF AMMONIUM BROMIDE AND OF GELATIN.

(Winther, 1923, 1924.)

The determinations were made by measurements of the electromotive force of a series of elements of the type.



where x is a mixture of Ag Br and of the solution in which its solubility is to be measured. Two identical elements were measured for each solution. The potential, π , very soon attained a constant value which did not change for many hours. The mean value for the exponents of the solubility products in solutions composed of various mixtures of ammonium salts, gelatin and erythrosine, was 11.92. Since the solubility product in all of the solutions had the same value it was concluded that the solubility of silver bromide in water is not altered by the addition of gelatin, erythrosine and small amounts of NH_4I and NH_4Cl . By the addition of bromide the solubility is decreased in accordance with the law of mass action.

Fusion-point data for mixtures of Ag Br + Na Br are given by Zemcznzy, 1926.

SOLUBILITY OF SILVER BROMIDE IN AQUEOUS AMMONIA SOLUTIONS.

Results at 15°. (Bodländer, 1892.)			Results at 25°. (Bodländer and Fittig, 1901-02.)		Results at 25°. (Whitney and Melcher, 1903.)	
$d_{15.5}^{\circ}$ of Sat. Sol.	Gms. Mols. per Liter.		Gms. Mols. per 1000 Gms. H ₂ O.		Concentration per Liter.	
	NH ₃ .	Ag ₂ Br ₂ .	NH ₃ .	AgBr.	G. Mols. NH ₃ .	G. Atoms Ag.
0.9932	1.085	0.0011	0.1932	0.00060	0.0764	0.000276
0.9853	2.365	0.0031	0.3849	0.00120	0.115	0.000391
0.9793	3.410	0.0050	0.7573	0.00223	0.268	0.000941
0.9720	4.590	0.0074	1.965	0.00692	0.273	0.00107
0.9655	5.725	0.0101	3.024	0.01163	0.450	0.00170
			5.244	0.02443	0.497	0.00159

SOLUBILITY OF SILVER BROMIDE IN AQUEOUS SOLUTIONS OF:

Ammonia at 0°. (Jarry, 1899.)				Monomethyl Amine at 11.5°. (Jarry.)	
Grams per 100 cc. Solution.				Gms. per 100 cc. Solution.	
NH ₃ Gas.	AgBr.	NH ₃ Gas.	AgBr.	NH ₂ CH ₃ .	AgBr.
3.07	0.080	26.27	1.067	11.01	0.07
4.88	0.096	31.26	1.568	13.17	0.12
6.69	0.172	33.89	1.987	15.13	0.16
8.29	0.212	36.52	2.669	17.97	0.28
11.51	0.349	37.22	2.888	32.58	0.55
15.32	0.557	37.70	2.930	35.62	0.73
18.09	0.722	39.26	2.892	43.11	1.27
19.53	0.741	39.95	2.852	48.44	2.89

Br

SOLUBILITY OF SILVER BROMIDE IN AQUEOUS SOLUTIONS OF METHYL AMINE AND OF ETHYL AMINE AT 25°.

(Bödländer and Eberlein, 1903; Wuth, 1902.)

In Methyl Amine.			In Ethyl Amine.		
Total Base.	AgBr.	Free Base.*	Total Base.	AgBr.	Free Base.*
1.017	0.0025	1.012 (B. & E.)	0.483	0.00231	0.478 (B. & E.)
0.508	0.0013	0.505 (B. & E.)	0.200	0.00097	0.198 "
0.203	0.00049	0.202 (B. & E., W.)	0.100	0.000475	0.099 "
0.102	0.00026	0.102 (B. & E.)	0.103	0.000711	... (W.)
0.0947	0.00041	... (W.)	0.06572	0.000258	... "
0.051	0.00012	0.051 (B. & E.)	0.05512	0.000193	... "
0.04	0.00034	... (W.)	0.03942	0.000137	... "
0.02	0.00026	... (W.)	0.01272	0.0000867	... "

* The free base is found by subtracting from the total base two mols. of base for each atom of dissolved Ag.

SOLUBILITY OF SILVER BROMIDE IN AQUEOUS SOLUTIONS OF MERCURIC NITRATE AT 25°.

(Morse, 1902.)

Mols. HgNO ₃ (HNO ₃) per Liter.	Mols. AgBr per Liter.	Gms. AgBr per Liter.	Mols. HgNO ₃ (HNO ₃) per Liter.	Mols. AgBr per Liter.	Gms. AgBr per Liter.
1	0.03660	6.878	0.025	0.00459	0.863
0.10	0.00873	1.640	0.0125	0.00329	0.618
0.05	0.00639	1.200	0.0100	0.00306	0.575

Since HNO₃ was present in all cases, its influence on the solubility was examined. It was found that no appreciable differences were obtained with concentrations varying between 0.1 and 2 normal HNO₃. Both crystallized and amorphous silver bromide gave identical results.

SOLUBILITY OF SILVER BROMIDE IN AQUEOUS SALT SOLUTIONS.
(Mees and Piper, 1912.)

	Aqueous Solution.	t°.	Gms. AgBr per Liter.
Aq. 1 per cent	Sodium Thiosulfate	?	2.06
"	Ammonium Thiocyanate	"	0.03
"	Ammonium Carbonate	"	0.004
"	Sodium Sulfate	"	0.055
"	Thiocarbamide	"	1.49

SOLUBILITY OF SILVER BROMIDE IN AQUEOUS SALT SOLUTIONS.
(Valenta, 1894; see also Cohn, 1895.)

Salt Solution.	t°.	Gms. AgBr per 100 Gms. Aq. Solution of Concentration:				
		1:100.	5:100.	10:100.	15:100.	20:100.
Sodium Thio Sulphate	20	0.35	1.90	3.50	4.20	5.80
" " Calc. by Cohn	20	0.50	2.40	4.59	6.58	8.40
Sodium Sulphite	25	...	...	0.04	...	0.08
Potassium Cyanide	25	...	6.55	...	...	...
" " Calc. by Cohn	25	...	6.85	...	...	...
Potassium Sulphocyanide	25	...	...	0.73	...	...
Ammonium Sulphocyanide	20	...	0.21	2.04	5.30	...
Calcium Sulphocyanide	25	...	...	0.53	...	...
Barium Sulphocyanide	25	...	...	0.35	...	...
Aluminum Sulphocyanide	25	...	...	4.50	...	...
Thio Carbamide	25	...	...	1.87	...	...
Thio Cyanime	25	0.08	0.35	0.72	...	...

NOTE. — Cohn shows that the lower results obtained by Valenta are due to the excess of solid AgBr used and the consequent formation of the less soluble di salt, $3(\text{Ag}_2\text{O}_3\text{Na})_2$, instead of the more soluble tri salt, $(\text{Ag}_2\text{O}_3\text{Na})_2\text{Na}_2\text{S}_2\text{O}_3$.

100 cc. H_2O containing 10 per cent of normal mercuric acetate, $\text{Hg}(\text{C}_2\text{H}_3\text{O}_2)_2 + \text{Aq.}$, dissolve 0.0122 gm. AgBr at 20°.

100 gms. NaCl in conc. aq. solution dissolve 0.474 gm. AgBr at 15°.

100 gms. NaCl in 21 per cent solution dissolve 0.182 gm. AgBr at 15°.

100 gms. KBr in conc. solution dissolve 3.019 gms. AgBr at 15°.

95 gms. NaCl + 10 gms. KBr in conc. aq. solution dissolve 0.075 gm. AgBr at 15°.
(Schierholz, 1890.)

SOLUBILITY OF SILVER BROMIDE IN AQUEOUS POTASSIUM BROMIDE AT 25°.
(Hellwig, 1900.)

Mols. KBr per Liter	2.76	3.68	4.18	4.44	4.864
Gms. KBr per Liter	2.20	7.50	13.50	17.95	26.44

SOLUBILITY OF SILVER BROMIDE IN AQUEOUS SOLUTIONS OF SODIUM SULFITE.

Results at Room Temperature (?).
(Mees and Piper, 1912.)

Gms. per Liter.		Gms. per Liter.	
Na_2SO_3 .	AgBr.	Na_2SO_3 .	AgBr.
0.08	0.000746	4.85	0.0329
0.17	0.00219	9.47	0.05264
0.30	0.00393	17.65	0.116
0.59	0.00448	38.2	0.265
1.13	0.00865	70.75	0.57
2.08	0.01585	83.75	0.79

Results at 25°.
(Luther and Leubner, 1912a.)

Gms. Formula Weights per Liter.	
SO_3'' .	Ag'.
0.232	0.0025
0.406	0.0023*
0.448	0.0023*
0.466	0.0053
0.474	0.0055
0.675	0.0084

SILVER BROMIDE

SOLUBILITY OF SILVER BROMIDE IN AQUEOUS SOLUTIONS OF SODIUM THIOSULFATE AT 35°.

(Richards and Faber, 1899.)

Gms. Cryst. Na ⁺ Thiosulfate per Liter.	Gms. AgBr Dissolved per Gm. of Thiosulphate.	Mols. AgBr Dissolved per Mol. of Na ₂ S ₂ O ₃ .
100	0.376	0.496
200	0.390	0.515
300	0.397	0.524
400	0.427	0.564

100 cc. of 3 % AgNO₃ solution dissolve 0.04 gm. AgBr at 25°. (Hellwig, 1900.)

SOLUBILITY OF SILVER BROMIDE IN AQUEOUS SOLUTIONS OF POTASSIUM THIOCYANATE AT 25°.

(Randall and Halford, 1930)

This system was studied by the authors as a case of equilibrium in a chemical reaction involving formation of a complex ion. The assumed reaction is $\text{AgBr} + 2\text{CNS}^- = \text{Ag}(\text{CNS})_2^- + \text{Br}^-$, but the solubility cannot be accounted for by the formation of a single complex ion $\text{Ag}(\text{CNS})_2^-$. The results of the analyses of the saturated solutions are expressed in molalities.

Total (KSCN)	(Ag Br)	free (KCNS)
0.2510	0.0011	0.249
0.2702	0.0012	0.267
0.5205	0.0095	0.501
0.5819	0.0085	0.564
0.7577	0.0285	0.701
0.7762	0.0307	0.715
1.0089	0.0663	0.875

SOLUBILITY OF SILVER BROMIDE IN CONCENTRATED SOLUTIONS OF HALOGEN SALTS.

(Dede and Walther, 1927.)

Molecular Composition of Solvent	Wt. in Gms. of 1 Gm. Equiv. of Solvent	- Millimols AgBr dissolved in one Gm. Equiv. of Solvent at			
		20°	40°	60°	80°
KBr+10H ₂ O	299.18	22.17	24.06	27.17	31.81
½CaBr ₂ +10H ₂ O	280.12	9.37	11.09	13.18	16.01
HBr+10H ₂ O	261.09	6.86	8.11	9.72	12.15
KBr+20H ₂ O	479.3	3.04	3.78	4.94	6.75
½CaBr ₂ +20H ₂ O	460.3	1.663	2.23	3.19	4.47
HBr+20H ₂ O	441.3	1.312	1.87	2.70	3.94
KBr+30H ₂ O	659.5	1.068	1.521	2.24	3.34
½CaBr ₂ +30H ₂ O	640.4	0.663	1.021	1.60	2.51
HBr+30H ₂ O	621.4	0.605	0.913	1.496	2.31

EQUILIBRIUM BETWEEN MIXED CRYSTALS OF SILVER
BROMIDE AND SILVER CHLORIDE AND HALOGEN SOLUTIONS
(Yutzy and Kolthoff, 1937.)

The experiments were made by adding a measured volume of standard AgNO_3 solution to mixtures of NaCl and KCl solutions of known composition. After precipitation the solutions were made up to known volumes and the suspensions shaken for various periods of time. The bromide content of the centrifuged supernatant solution was determined by the D'Ans and Hüfer method (Z. Angew. Chem. 47 73 1934.) From this the ratio of Ag Br to Ag Cl in the precipitate could be calculated by difference.

The results are given in terms of the mol. percent bromide in the precipitate and the final bromide concentration of the solution. By means of variation in the mode of mixing the constituents is shown that equilibrium was reached in all cases. The results show the distribution coefficient of bromide between aq. solution and mixed crystals of $\text{AgCl}+\text{AgBr}$ at 27° and at 98° .

SOLUBILITY OF SILVER BROMIDE IN LIQUID AMMONIA

t°	Gms. AgBr per 100 gms. NH_3	
0	2.40	(Linhard and Stephan, 1933, 1934.)
25	5.92	(Hunt and Boncyk, 1933.)

100 gms. liquid sulfur dioxide dissolve 0.003 gm. AgBr at 0° (Jander and Wickert, 1936; Jander and Ruppold, 1937).

SOLUBILITY OF SILVER BROMIDE IN METHYL AND IN
ETHYL ALCOHOL AT 25° .

(Koch, 1930.)

From conductivity and E.M.F. measurements the ratios of the solubilities of silver bromide in water and alcohols were calculated. By means of these figures and previously determined results for the solubility of silver bromide in water the following values were obtained.

Solvent	Mols. AgBr per liter	Gms. AgBr per liter
Water	7.8×10^{-7}	0.000146
CH_3OH	3.0×10^{-8}	0.0000056
$\text{C}_2\text{H}_5\text{OH}$	3.7×10^{-9}	0.00000013

The solubility product of AgBr in CH_3OH at 25° in equiv. gms. per 1000 gms. CH_3OH is 5.8×10^{-16} (Buckley & Hartley, 1929.)

SILVER BROMIDE THIOSINAMINE $\text{AgBr} \cdot \text{NH}_2 \cdot \text{CS} \cdot \text{NHC}_3\text{H}_5$

SOLUBILITY OF SILVER BROMIDE - THIOSINAMINE
(ALLYL THIO CARBAMIDE) IN WATER
(Sheppard and Hudson, 1927.)

The solutions were shaken at constant temperature for 48 hours and the amount of compound dissolved determined by conversion to silver sulfide.

t°	AgBr.NH ₂ .CS.NHC ₂ H ₅ per liter sat. aq. solution	
	Gms.	Gm. Mols. x 10 ⁻⁴
15	0.0446	1.46
25	0.071	2.33
35	0.121	3.94
50	0.293	9.63

FUSION POINT DATA FOR MIXTURES OF SILVER BROMIDE AND
OTHER COMPOUNDS

AgBr-AgCl	(Mönkemeyer, 1906.)
AgBr-Ag I	"
AgBr-AlBr	(Kendall, Crittenden, and Miller, 1923.)
AgBr-KBr ³	(Sandonnini, 1912; Zemczuzny, 1926)
AgBr-NaBr	(Sandonnini and Scarpa, 1913; Zemczuzny, 1926.)
AgBr-PbBr ₂	(Matthes, 1911.)

Note.—Freezing or Melting Point Curves as Solubility Data.

When a mixture of two compounds, rendered liquid by elevation of temperature, is gradually cooled, a point will be reached at which one or the other of the constituents will separate as a solid. This point represents the solubility of the one compound in the other. The method involved, differs principally from that ordinarily employed for solubility determinations, in that the composition of the mixture remains constant while the saturation temperature is being approached, instead of the reverse procedure.

A considerable amount of data of this character is available but, after careful consideration, it has been decided that references only will be given to such results in the present volume, except in cases of mixture of well known compounds or of those in which water is one of the constituents.

SILVER BROMATE AgBrO₃.

BrO

SOLUBILITY IN WATER.

t°.	Gms. AgBrO ₃ per Liter.	Authority.
20	1.586	(Böttger, 1903.)
24.5	1.911	(Noyes, 1900.)
25	1.68	(Longi, 1883.)
27	1.71	(Whitby, 1910, see note, p. 608.)
25	1.949	(Hill, 1917.)

SOLUBILITY OF SILVER BROMATE IN WATER.
(Reedy, 1921.)

t°.	Gms. AgBrO ₃ per 100 gms. H ₂ O.	t°.	Gms. AgBrO ₃ per 100 gms. H ₂ O.	t°.	Gms. AgBrO ₃ per 100 gms. H ₂ O.
25.....	0.196	50.....	0.433	75.....	0.832
30.....	0.227	55.....	0.497	80.....	0.936
35.....	0.269	60.....	0.570	85.....	1.055
40.....	0.316	65.....	0.648	90.....	1.325
45.....	0.371	70.....	0.735		

A transition point near 98°5 is indicated.

SOLUBILITY OF SILVER BROMATE IN AQUEOUS ACETIC ACID AT 25°.
(Hill, 1917.)

Normality of Aq. Acetic Acid.	Gms. AgBrO ₃ per Liter.	Normality of Aq. Acetic Acid.	Gms. AgBrO ₃ per Liter.
0.0498	1.9429	0.4988	1.863
0.0997	1.9379	0.9975	1.8013
0.1995	1.9206	1.8721	1.6178

SOLUBILITY OF SILVER BROMATE IN AQUEOUS AMMONIA AND NITRIC
ACID SOLUTIONS AT 25°.

(Longi, 1883.)

	Solvent.	Gms. AgBrO ₃ per	
		1000 cc. Sol.	1000 Gms. Sol.
Ammonia	Sp. Gr. 0.998 = 5%	35.10	35.54
Ammonia	Sp. Gr. 0.96 = 10%	443.6	462.5
Nitric Acid	Sp. Gr. 1.21 = 35%	3.81	3.12

SOLUBILITY OF SILVER BROMATE AT 24.5° IN AQUEOUS
SOLUTIONS OF:

Silver Nitrate (Noyes).				Potassium Bromate (N.).			
Normal Content.		Gms. per Liter.		Normal Content.		Gms. per Liter.	
AgNO ₃ .	AgBrO ₃ .	AgNO ₃ .	AgBrO ₃ .	KBrO ₃ .	AgBrO ₃ .	KBrO ₃ .	AgBrO ₃ .
0.0	0.0081	0.0	1.911	0.0	0.0081	0.0	1.911
0.0085	0.0051	1.445	1.203	0.0085	0.00519	1.42	1.225
0.0346	0.0022	5.882	0.510	0.0346	0.00227	5.78	0.536

SOLUBILITY OF SILVER BROMATE IN AQUEOUS SALT SOLUTIONS AT 23°.
(Dalton, Pomeroy and Weymouth, 1924.)

Constant rotation for at least 16 hours was employed and equilibrium was approached both from above and below.

Salt.	Gm. equiv. salt per 1000 gms. H ₂ O.	Density of sat. sol.	Millimols. AgBrO ₃ per 1000 gms. H ₂ O.	Salt.	Gm. equiv. salt per 1000 gms. H ₂ O.	Density of sat. sol.	Millimols. AgBrO ₃ per 1000 gms. H ₂ O.
None (=H ₂ O) . .	0.0	0.9990	8.062	Ba(NO ₃) ₂ . .	0.025	1.0018	9.088
KClO ₄	0.025	1.0010	8.716	» . .	0.05	1.0046	9.655
»	0.5	1.0033	9.190	» . .	0.10	1.0098	10.373
»	0.10	1.0074	9.706	Na ₂ SO ₄ . . .	0.05	1.0025	9.965
K ₂ SO ₄	0.025	1.0009	9.292	» . . .	0.10	1.0059	10.973
»	0.05	1.0028	10.015	» . . .	1.00	1.0622	18.619
»	0.10	1.0062	11.092	CdSO ₄	0.10	1.0017	10.405
Mg(NO ₃) ₂	0.025	1.0003	8.935	» . . .	0.50	1.0492	13.349
»	0.05	1.0018	9.414	Cr(NO ₃) ₃ . .	0.0125	1.0002	8.888
»	0.10	1.0046	10.090	» . . .	0.025	1.0014	9.336
MgSO ₄	0.02	—	8.92	KNO ₃	0.040	—	9.12
»	0.051	—	9.67	» . . .	0.100	—	9.92
»	0.100	—	10.30	» . . .	0.200	—	11.06
»	0.1988	—	11.38	» . . .	0.394	—	12.66

SILVER BROMATE AgBrO_3 SOLUBILITY OF SILVER BROMATE IN AQUEOUS SOLUTIONS
OF SODIUM NITRATE AND SODIUM PICRATE AT 20°.

(Gilbert, 1929.)

Molality of Salt Solution		Molality of dissolved AgBrO_3
NaNO_3	$\text{NaOC}_6\text{H}_2(\text{NO}_2)_3$	
0.00	0.10	0.00848
0.10	0.00	0.00840
0.05	0.05	0.00838

SOLUBILITY OF SILVER BROMATE IN AQUEOUS SOLUTIONS
OF METHYL ALCOHOL AND OF ETHYL ALCOHOL AT 25°.

(Owen, 1933; Newman, 1934.)

Results for Methyl Alcohol			Results for Ethyl Alcohol		
Wt. Percent CH_3OH in Solvent	d_{25} of Solvent	Millimols AgBrO_3 per liter Sat. Solution	Wt. percent $\text{C}_2\text{H}_5\text{OH}$ in Solvent	d_{25} of Solvent	Millimols AgBrO_3 per liter Sat. Solution
0.0	0.9989	8.12	0.0	0.9989	8.12
10.0	0.9802	5.51	10.0	0.9804	5.53
20.0	0.9650	3.79	20.0	0.9664	3.86
30.0	0.9492	2.65	30.0	0.9507	2.78
40.0	0.9318	1.82	40.0	0.9315	1.97
50.0	0.9123	1.24	50.0	0.9099	1.36
60.0	0.8908	0.83			

SOLUBILITY OF SILVER BROMATE IN AQUEOUS SOLUTIONS
IN PROPYL ALCOHOL AND IN ISO PROPYL ALCOHOL AT 25°.

(Owen, 1933; Newman, 1934.)

BrO

Results for <u>n</u> Propyl Alcohol			Results for <u>iso</u> Propyl Alcohol	
Wt. Percent $\text{C}_3\text{H}_7\text{OH}$ in Solvent	d_{25} of Solvent	Millimols AgBrO_3 per liter Sat. Solution	Wt. percent $(\text{CH}_3)_2\text{CHOH}$ in Solvent	Millimols AgBrO_3 per liter Sat. Solution
10	0.9821	5.80	10	5.5
20	0.9674	4.36	20	3.95
30	0.9472	3.31	30	2.92
40	0.9261	2.41	40	2.1
50	0.9051	1.63	50	1.5

SOLUBILITY OF SILVER BROMATE IN AQUEOUS SOLUTIONS
OF ACETONE, MANNITOL AND GLYCINE AT 25°.

(Owen, 1933.)

Wt. Percent Organic Cmpd. in Solvent	In Acetone		In Mannitol		In Glycine	
	d_{25} of aq. Acetone	Millimols AgBrO_3 per liter Sat. Sol.	d_{25} of aq. Mannitol	Millimols AgBrO_3 per liter Sat. Sol.	d_{25} of aq. Glycine	Millimols AgBrO_3 per liter Sat. Sol.
5	—	—	1.0147	8.24	1.0184	12.9
10	0.9845	5.92	1.0328	8.38	1.0395	18.4
15	—	—	1.0513	8.51	1.0613	24.9
20	0.9700	4.29	—	—	—	—
30	0.9537	3.00	—	—	—	—
40	0.9355	2.03	—	—	—	—

SILVER BROMATE AgBrO_3 SOLUBILITY OF SILVER BROMATE IN AQUEOUS SOLUTIONS
OF ETHYLENE GLYCOL AND OF GLYCEROL AT 25°.

(Owen, 1933.)

Results for Ethylene Glycol				Results for Glycerol			
Wt. Percent $\text{OHCH}_2\text{CH}_2\text{OH}$ in Solvent	d ₂₅ of aq. Solvent	Millimols AgBrO_3 per liter Sat. Sol.		Wt. Percent $\text{OHCH}_2\text{CHOHCH}_2\text{OH}$ in Solvent	d ₂₅ of aq. Solvent	Millimols AgBrO_3 per liter Sat. Sol.	
10	1.0097	7.26		10	1.0207	7.80	
20	1.0228	6.50		20	1.0453	7.49	
30	1.0362	5.85		30	1.0706	7.15	
40	1.0496	5.26		40	1.0971	6.84	
50	1.0624	4.70		50	1.1239	6.48	
70	1.0851	3.61		60	1.1511	6.08	
				70	1.1784	5.59	
				80	1.2054	4.94	

SILVER METHIONATE $\text{Ag}_2\text{CH}_2\text{O}_6\text{S}_2$

SOLUBILITY IN WATER

(Backer and Terpstra, 1929.)

t°	Gms. $\text{Ag}_2\text{CH}_2\text{O}_6\text{S}_2$ per 100 gms. H_2O	Solid Phase
25°	62.5	$\text{Ag}_2\text{CH}_2\text{O}_6\text{S}_2 \cdot 2\text{H}_2\text{O}$
25°	45.05	$\text{Ag}_2\text{CH}_2\text{O}_6\text{S}_2$

SILVER ACETATE CH_3COOAg .

SOLUBILITY IN WATER.

(Nernst, 1889; Arrhenius, 1893; Goldschmidt, 1898; Nauman and Rucker, 1905; Raupenstrauch, 1885; Wright and Thompson, 1884, 1885.)

t°	Gms. $\text{Ag}(\text{C}_2\text{H}_3\text{O}_2)$ per Liter.	t°	Gms. $\text{Ag}(\text{C}_2\text{H}_3\text{O}_2)$ per Liter.	t°	Gms. $\text{Ag}(\text{C}_2\text{H}_3\text{O}_2)$ per Liter.
0	7.22	25	11.2	50	16.4
10	8.75	30	12.1	60	18.9
15	9.4	40	14.1	70	21.8
20	10.4			80	25.2

At 18° one liter sat. solution in water contains 10.03 gms. AgCH_3COO (Larsson and Adell, 1931).At 25° one liter sat. solution in water contains 11.07 gms. AgCH_3COO (Jaques, 1909); 11.13 gms. (Hill and Simmons, 1909); (Knox and Will, 1919); 11.09 gms, d₂₅ sat. sol. = 1.0047 (MacDougall, 1930; MacDougall and Rehner, 1934; MacDougall and Bartsch, 1936; MacDougall and Larson, 1937).SOLUBILITY OF SILVER ACETATE AT 18° IN AQUEOUS SOLUTIONS OF:
(Larsson and Adell, 1931.)

Sodium Nitrate		Sodium Acetate	
Moles per liter Sat. Sol.		Moles per liter Sat. Sol.	
NaNO_3	AgCH_3COO	NaCH_3COO	AgCH_3COO
0.0	0.0601	0.0503	0.0429
0.2	0.0686	0.1005	0.0317
0.4	0.0734	0.2011	0.0223
0.6	0.0767	0.2513	0.0211
0.8	0.0790	0.503	0.0153
1.0	0.0810	1.005	0.0121

SOLUBILITY OF SILVER ACETATE IN AQUEOUS SOLUTIONS OF:

Silver Nitrate.			Sodium Acetate.		
Gms. AgNO ₃ per Liter.	Gms. CH ₃ COOAg per Liter at: 16° (Nernst). 19.8° (Arrhenius).		Gms. CH ₃ COONa per Liter.	Gms. CH ₃ COOHg per Liter at: 16° (N., N. and R.). 18.6° (A.).	
0	10.05	9.85	0	10.05	9.9
5	8.2	7.9	5	6.3	6.6
10	7.0	6.6	10	4.6	4.9
15	6.4	5.5	15	3.8	4.1
20	5.7	4.5	20	3.3	3.5
30	4.4	...	30	...	2.8
40	3.2	...	40	...	2.4

SOLUBILITY OF SILVER ACETATE IN AQUEOUS SALT SOLUTIONS AT 25°. (Jaques, 1910.)

Aq. Solution of;	Gms. Salt per Liter.	Gms. AgC ₂ H ₃ O ₂ per Liter.	Aq. Solution of;	Gms. Salt per Liter.	Gms. AgC ₂ H ₃ O ₂ per Liter.
Water alone	0	11.08	Potassium Acetate	2.22	9.60
Cadmium Acetate	1.15	10.39	" "	22.2	4.43
" "	5.76	8.10	" "	111	2.41
" "	11.52	6.71	" "	222	2.18
" "	57.6	4.33	Silver Nitrate	2.77	9.93
" "	115.2	3.95	" "	5.55	9
Lead Acetate	1.63	10.69	" "	11.10	7.41
" "	8.13	9.45	" "	22.21	5.81
" "	16.26	8.34	Sodium Acetate	1.97	9.27
" "	81.3	7.26	" "	19.7	4.21
" "	162.6	5.99	" "	98.5	2.33
			" "	197	2.07

CH

SOLUBILITY OF SILVER ACETATE IN AQUEOUS SOLUTIONS OF POTASSIUM NITRATE AT 25°.

(MacDougall, 1930).

m KNO ₃	d ₂₅ of Sat. Sol.	m AgCH ₃ COO	c AgCH ₃ COO	m KNO ₃	d ₂₅ of Sat. Sol.	m AgCH ₃ COO	c AgCH ₃ COO
0.0501	1.0077	0.06685	0.06642	0.8021	1.0537	0.08786	0.08449
0.1006	1.0115	0.07281	0.07204	1.0155	1.0658	0.09019	0.08600
0.2001	1.0180	0.07659	0.07547	1.2431	1.0784	0.09214	0.08708
0.3018	1.0241	0.07941	0.07791	1.5437	1.0944	0.09453	0.08828
0.4010	1.0298	0.08171	0.07982	2.0371	1.1186	0.09754	0.08923
0.5013	1.0366	0.08344	0.08124	2.5355	1.1426	0.09997	0.08973
0.6040	1.0417	0.08498	0.08233	3.0139	1.1653	0.10163	0.08960

m = molality or moles of AgCH₃COO per 1000 gms. of water.c = molarity or moles of AgCH₃COO per 1000 cc. of solution.

SILVER ACETATE, AgCH_3COO

SOLUBILITY OF SILVER ACETATE IN AQUEOUS SOLUTIONS OF NITRATES AT 25°.
(MacDougall and Rehner, Jr., 1934.)

In Aqueous Lithium Nitrate

In Aqueous Sodium Nitrate

gms of Sat. Solution	Moles per 1000 gms. H ₂ O	
	LiNO_3	AgCH_3COO
1.0050	0.0	0.06666
1.0067	0.04817	0.07033
1.0097	0.0994	0.07260
1.0143	0.1996	0.07799
1.0185	0.2997	0.08198
1.0226	0.4002	0.08490
1.0269	0.5004	0.08765
1.0314	0.6101	0.09033
1.0395	0.8195	0.09491
1.0461	0.9975	0.09819
1.0561	1.2636	0.1031
1.0649	1.4997	0.1072
1.0925	2.2835	0.1195
1.1002	2.5193	0.1229
1.1172	3.0305	0.1315
1.1444	4.0221	0.1479
1.2050	6.0125	0.1851
1.2560	8.0153	0.2274
1.3007	10.055	0.2768

gms of Sat. Solution	Moles per 1000 gms. H ₂ O	
	NaNO_3	AgCH_3COO
1.0086	0.04776	0.07040
1.0108	0.09648	0.07287
1.0162	0.1914	0.07640
1.0216	0.2868	0.08032
1.0269	0.3840	0.08246
1.0310	0.4767	0.08414
1.0371	0.5743	0.08615
1.0470	0.7631	0.08910
1.0578	0.9533	0.09177
1.0629	1.0504	0.09266
1.0718	1.2398	0.09464
1.0857	1.5325	0.09766
1.1038	1.9108	0.09958
1.1246	2.3884	0.1027
1.1458	2.8723	0.1059
1.1846	3.9954	0.1106
1.2628	6.0191	0.113
1.3212	8.0098	0.1123
1.3753	10.225	0.1109

In Aqueous Calcium Nitrate

In Aqueous Strontium Nitrate

gms of Sat. Solution	Moles per 1000 gms. H ₂ O	
	$\text{Ca}(\text{NO}_3)_2$	AgCH_3COO
1.0062	0.00499	0.06825
1.0071	0.00993	0.06920
1.0084	0.01996	0.07187
1.0126	0.04980	0.07691
1.0191	0.09970	0.08365
1.0318	0.1996	0.09311
1.0560	0.3985	0.1067
1.0792	0.5985	0.1170
1.1225	0.9962	0.1363
1.1726	1.4916	0.1588
1.2634	2.4958	0.2034
1.3766	3.9871	0.2759

gms of Sat. Solution	Moles per 1000 gms. H ₂ O	
	$\text{Sr}(\text{NO}_3)_2$	AgCH_3COO
1.0063	0.00497	0.06768
1.0071	0.01001	0.06870
1.0090	0.02002	0.07133
1.0134	0.05038	0.07628
1.0229	0.1008	0.08178
1.0402	0.2009	0.08936
1.0727	0.4022	0.1001
1.1046	0.6036	0.1081
1.1645	1.0064	0.1218
1.2338	1.5072	0.1354
1.3575	2.5092	0.1588
1.4605	3.4941	0.1632

In Aqueous Barium Nitrate

In Aqueous Lanthanum Nitrate

gms of Sat Solution	Moles per 1000 gms. H ₂ O	
	$\text{Ba}(\text{NO}_3)_2$	AgCH_3COO
1.0050	0.0	0.06666
1.0064	0.005012	0.06796
1.0076	0.01001	0.06910
1.0100	0.01998	0.07127
1.0161	0.05025	0.07597
1.0273	0.1002	0.08104
1.0489	0.2009	0.08831
1.0697	0.3014	0.09361
1.0796	0.3500	0.09572
1.0876	0.3902	0.09755

gms of Sat. Solution	Moles per 1000 gms. H ₂ O	
	$\text{La}(\text{NO}_3)_3$	AgCH_3COO
1.0060	0.001431	0.06809
1.0073	0.004859	0.07109
1.0085	0.008374	0.07407
1.0122	0.01839	0.08231
1.0228	0.05047	0.1034
1.0389	0.1016	0.1304
1.0715	0.2113	0.1746
1.1210	0.3908	0.2315
1.1613	0.5434	0.2771
1.2558	0.9216	0.3856
1.4571	1.8568	0.6764
1.6277	2.8185	1.0487

SOLUBILITY OF SILVER ACETATE IN AQUEOUS SOLUTIONS OF NITRIC ACID AT 25°.
(Hill and Simmons, 1909.)

Normality of Aq. HNO ₃ .	Per cent HNO ₃ in Solvent.	d ₂₅ of Sat. Sol.	Gms. AgC ₂ H ₃ O ₂ per Liter Sat. Sol.
0	0	1.005	11.13
0.50	3.096	1.072	85.31
1	6.128	1.140	161.9
2	11.757	1.267	307.4
4.02	22.386	1.470	549.3
5.03	27.328	1.561	656
6.44	33.813	1.670	792.2

Results are also given for the solubility of AgC₂H₃O₂ + AgNO₃ in Aq. HNO₃ at 25°.

SOLUBILITY OF SILVER ACETATE IN AQUEOUS SOLUTIONS OF ACETIC ACID AT 23°.
(Knox and Will, 1919.)

Saturation was secured by constant agitation in a thermostat.

Gm. equiv. CH ₃ COOH per liter.	Gms. CH ₃ COO Ag per liter.	Gm. equiv. CH ₃ COOH per liter.	Gms. CH ₃ COO Ag per liter.	Gm. equiv. CH ₃ COOH per liter.	Gms. CH ₃ COO Ag per liter.
0.0	11.13	5.99	8.72	12.32	5.33
1.00	10.73	6.80	8.29	12.97	4.96
2.00	10.32	8.01	7.73	13.97	4.29
2.98	9.98	8.97	7.31	14.96	3.43
4.19	9.52	9.96	6.78	15.93	2.48
4.98	9.19	11.02	6.15	17.28	1.09

100 gms. sat. solution of silver acetate in acetic acid contain 0.094 gm. CH₃COO Ag at 76° and 0.204 gm. at 115°.
(Kendall and Adler, 1921.)

SOLUBILITY OF SILVER ACETATE IN AQUEOUS SOLUTIONS OF ETHYL ALCOHOL AT 25°.

CH

(MacDougall and Bartsch, 1936.)

Wt. Percent C ₂ H ₅ OH in Solvent	d ₂₅ of Sat. Sol.	Moles AgCH ₃ COO per liter Sat. Sol.	Wt. Percent C ₂ H ₅ OH in Solvent	d ₂₅ of Sat. Sol.	Moles AgCH ₃ COO per liter Sat. Sol.
5.0	0.9955	0.0577	25.06	0.9616	0.0294
7.62	0.9898	0.0523	29.82	0.9530	0.0251
9.0	0.9882	0.0506	30.05	0.9926	0.0249
15.03	0.9784	0.0413	40.27	0.9323	0.0180
19.96	0.9696	0.03	50.14	0.9102	0.0124

Results are also given for the solubility at 25° of silver acetate in approximately 10, 20 and 30 percent aqueous ethyl alcohol mixtures containing varying concentrations of KNO₃, NaNO₃, LiNO₃, Ca(NO₃)₂, Sr(NO₃)₂ and Ba(NO₃)₂.

SOLUBILITY OF SILVER ACETATE IN AQUEOUS SOLUTIONS OF ACETONE AT 25°.

(MacDougall and Larson, 1937.)

Wt. Percent (CH ₃) ₂ CO in Solvent	d ₂₅ of Sat. Sol.	Moles AgCH ₃ COO per liter Sat. Sol.	Wt. Percent (CH ₃) ₂ CO in Solvent	d ₂₅ of Sat. Sol.	Moles AgCH ₃ COO per liter Sat. Sol.
9.27	0.9920	0.0516	20.03	0.9740	0.0322
9.81	0.9910	0.0499	20.50	0.9724	0.0319
10.35	0.9900	0.0481	28.25	0.9592	0.0214
18.83	0.9758	0.0324	29.23	0.9584	0.0213
19.48	0.9748	0.0323	30.02	0.9564	0.0213

Results are also given for the solubility at 25° of silver acetate in approximately 10, 20 and 30 percent aqueous acetone mixtures containing varying concentrations of KNO₃, NaNO₃, Sr(NO₃)₂ and Ca(NO₃)₂.

SILVER ACETATE AgCH_3COO .

SOLUBILITY OF SILVER ACETATE IN AQUEOUS SOLUTIONS OF SEVERAL COMPOUNDS AT 25°. (Armstrong and Eyre, 1913.)

Aqueous Solution of:	Gms. Compound per 1000 Gms. H_2O .	Gms. $\text{AgC}_2\text{H}_3\text{O}_2$ per 1000 Gms. Sat. Sol.	Aqueous Solution of:	Gms. Compound per 1000 Gms. H_2O .	Gms. $\text{AgC}_2\text{H}_3\text{O}_2$ per 1000 Gms. Sat. Sol.
Water	0	11.08	Propyl Alcohol	15	9.88
Acetaldehyde	11	10.13	" "	60	8.03
Paraldehyde	11	8.92	Glycerol	9.21	8.66
"	33	9.16	Glycol	15.5	10.86
Isobutyl Alcohol	66.4	7.55	"	62.1	8.44

100 gms. liquid SO_2 dissolve 0.017 gm. AgCH_3COO at 0°. (Jander and Ruppold, 1937.)

SILVER Monochlor ACETATE $\text{AgCH}_2\text{ClCOO}$.

One liter aqueous solution contains 12.97 gms. $\text{AgCH}_2\text{ClCOO}$ at 16.9°. (Arrhenius, '93.)

SOLUBILITY OF SILVER MONO CHLOR ACETATE AT 16.9° IN AQUEOUS SOLUTIONS OF:

Silver Nitrate.		Sodium Chlor Acetate.	
Gms. AgNO_3 per Liter.	Gms. $\text{CH}_2\text{ClCOOAg}$ per Liter.	Gms. $\text{CH}_2\text{ClCOONa}$ per Liter.	Gms. $\text{CH}_2\text{ClCOOAg}$ per Liter.
0.0	12.97	0.0	12.97
9.6	10.05	3.88	10.05
17.0	7.55	7.77	8.16
		15.53	6.02
		31.07	4.19
		58.26	3.26

SOLUBILITY OF SILVER MONO CHLOR ACETATE IN AQUEOUS SOLUTIONS OF BARIUM NITRATE AT 25°.

(MacDougall and Rehner, Jr., 1934.)

d_{25} of Sat. Sol.	Moles per 1000 gms. H_2O		d_{25} of Sat. Sol.	Moles per 1000 gms. H_2O	
	$\text{Ba}(\text{NO}_3)_2$	$\text{AgCH}_2\text{ClCOO}$		$\text{Ba}(\text{NO}_3)_2$	$\text{AgCH}_2\text{ClCOO}$
1.0097	0.0	0.07832	1.0319	0.09916	0.09493
1.0100	0.00493	0.07995	1.0535	0.2001	0.1035
1.0114	0.00987	0.08180	1.0739	0.2980	0.1099
1.0136	0.01990	0.08340	1.0846	0.3501	0.1131
1.0207	0.05000	0.08878	1.0922	0.3871	0.1151

100 gms. liquid sulfur dioxide dissolve 0.017 gm. AgCH_3COO at 0°. (Jander and Wickert, 1936.)

SILVER Monochlor ACETATE $\text{AgCH}_2\text{ClCOO}$ SOLUBILITY OF SILVER MONOCHLOR ACETATE IN AQUEOUS SOLUTIONS
OF NITRATES AT 25° .

(MacDougall and Rehner, Jr., 1934.)

In Aqueous Lithium Nitrate			In Aqueous Sodium Nitrate		
d_{25} of Sat. Sol.	Moles per 1000 gms. H_2O		d_{25} of Sat. Sol.	Moles per 1000 gms. H_2O	
	LiNO_3	$\text{AgCH}_2\text{ClCOO}$		NaNO_3	$\text{AgCH}_2\text{ClCOO}$
1.0123	0.05039	0.08199	1.0125	0.04979	0.08004
1.0191	0.2001	0.09026	1.0219	0.1994	0.08923
1.0277	0.4004	0.09772	1.0334	0.3990	0.09617
1.0440	0.8081	0.1081	1.0555	0.7975	0.1059
1.0696	1.5025	0.1186	1.0907	1.4930	0.1170
1.1210	2.9908	0.1436	1.1583	2.9847	0.1320
1.2079	6.0071	0.1648	1.3798	9.9368	0.1568

In Aqueous Potassium Nitrate			In Aqueous Calcium Nitrate		
d_{25} of Sat. Sol.	Moles per 1000 gms. H_2O		d_{25} of Sat. Sol.	1000 Moles per 1000 gms. H_2O	
	LiNO_3	$\text{AgCH}_2\text{ClCOO}$		$\text{Ca}(\text{NO}_3)_2$	$\text{AgCH}_2\text{ClCOO}$
1.0127	0.05005	0.08306	1.0102	0.00499	0.08118
1.0229	0.1999	0.09112	1.0127	0.01996	0.08503
1.0353	0.3971	0.09825	1.0363	0.1996	0.1063
1.0598	0.7980	0.1087	1.0611	0.3985	0.1208
1.0851	1.2464	0.1183	1.1066	0.7958	0.1412
1.1244	1.9923	0.1316	1.1782	1.4916	0.1728
1.1728	2.9960	0.1440	1.3786	3.9871	0.2550

In Aqueous Strontium Nitrate			In Aqueous Lanthanum Nitrate		
d_{25} of Sat. Sol.	Moles per 1000 gms. H_2O		d_{25} of Sat. Sol.	Moles per 1000 gms. H_2O	
	$\text{Sr}(\text{NO}_3)_2$	$\text{AgCH}_2\text{ClCOO}$		$\text{La}(\text{NO}_3)_3$	$\text{AgCH}_2\text{ClCOO}$
1.0100	0.004978	0.08139	1.0103	0.001431	0.8211
1.0133	0.01988	0.08466	1.0129	0.008374	0.08680
1.0279	0.09998	0.09524	1.0268	0.05047	0.1080
1.0452	0.1989	0.1044	1.0752	0.2113	0.1569
1.0786	0.3992	0.1175	1.1226	0.3908	0.1879
1.1103	0.6008	0.1274	1.2098	0.7371	0.2441
1.1407	0.7993	0.1362	1.3149	1.2013	0.3164
1.2394	1.4977	0.1606	1.4465	1.8568	0.4237
1.4180	2.9985	0.1975	1.6080	2.8185	0.5939

CH

SOLUBILITY OF SILVER MONOCHLORO ACETATE IN NITRIC ACID AT 25° .

(Hill and Simmons, 1909.)

Normality of Aq. HNO_3	Gms. HNO_3 per 100 Gms. Solvent.	d_{25} of Sat. Sol.	Gms. $\text{AgCH}_2\text{ClCO}_2$ per Liter.
0	0	1.0095	15.18
0.25	1.564	1.0426	50.33
0.50	3.096	1.0791	91.83
1	6.128	1.1473	167.3
2	11.757	1.2716	310.8
4	22.277	1.4749	549.1
5	27.185	1.5673	659.2

SILVER Dipropyl **ACETATE** $\text{AgC}_8\text{H}_{15}\text{O}_2$.

100 gms. H_2O dissolve 0.123 gm. $\text{AgC}_8\text{H}_{15}\text{O}_2$ at 11.7° , and 0.190 gm. at 72° .
(Fürth, 1888.)

SILVER Methyl Ethyl **ACETATE** $\text{Ag} \cdot \text{CH}_3 \cdot \text{CH}_2\text{CH}(\text{CH}_3)\text{COO}$.

SILVER Diethyl **ACETATE** $\text{Ag}[(\text{C}_2\text{H}_5)_2\text{CH} \cdot \text{COO}]$.

SILVER Trimethyl **ACETATE** $\text{Ag}(\text{CH}_3)_3\text{CCOO} \cdot ^*$

SOLUBILITY OF EACH IN WATER.
(Sedlitzky, 1887; Keppish, 1888; Stiassny, 1891.)

t°.	Gms. per 100 Gms. H_2O .			t°.	Gms. per 100 Gms. H_2O .		
	$\text{AgC}_8\text{H}_{15}\text{O}_2$.	$\text{AgC}_6\text{H}_{11}\text{O}_2$.	$\text{AgC}_4\text{H}_7\text{O}_2 \cdot ^*$		$\text{AgC}_8\text{H}_{15}\text{O}_2$.	$\text{AgC}_6\text{H}_{11}\text{O}_2$.	$\text{AgC}_4\text{H}_7\text{O}_2 \cdot ^*$
0	1.112	0.402	1.10	50	1.602	0.536	1.47
10	1.126	0.413	1.15	60	1.827	0.585	1.57
20	1.182	0.432	1.22	70	2.093	0.643	1.68
30	1.280	0.458	1.22	80	2.402	...	1.80

SILVER Phenyl **ACETATE** $\text{AgC}_6\text{H}_5\text{CH}_2\text{COO}$

100 cc. sat. solution in water contain 0.352 gm. $\text{Ag} \cdot \text{C}_6\text{H}_5\text{CH}_2\text{COO}$ at 25° .
(Larson, 1927.)

SILVER PROPIONATE $\text{C}_2\text{H}_5\text{COOAg}$.

SOLUBILITY IN WATER.
(Raupestrauch, 1885; Arrhenius, 1893; Goldschmidt, 1898.)

t°.	Gms. $\text{C}_2\text{H}_5\text{O}_2\text{Ag}$ per Liter.	t°.	Gms. $\text{C}_2\text{H}_5\text{O}_2\text{Ag}$ per Liter.	t°.	Gms. $\text{C}_2\text{H}_5\text{O}_2\text{Ag}$ per Liter.
0	5.12	20	8.36 (8.48)	50	13.35
10	6.78	25	9.06	70	17.64
18.2	8.36 (A)	30	9.93 (9.70)	80	20.30

100 cc. sat. solution in H_2O contain 0.9 gm. $\text{AgC}_2\text{H}_5\text{COO}$ at 25° .

(Larson, 1927.)

100 cc. sat. solution in H_2O contain 1.353 gm. $\text{AgC}_2\text{H}_5\text{COO}$ at 50° .

(Fuhner, 1924.)

SOLUBILITY OF SILVER PROPIONATE IN AQUEOUS SOLUTIONS OF:
(Arrhenius.)

Silver Nitrate at 19.7° .

Sodium Propionate at 18.2° .

Mols. per Liter.		Gms. per Liter.		Mols. per Liter.		Gms. per Liter.	
AgNO_3 .	$\text{C}_2\text{H}_5\text{O}_2\text{Ag}$.	AgNO_3 .	$\text{C}_2\text{H}_5\text{O}_2\text{Ag}$.	$\text{C}_2\text{H}_5\text{O}_2\text{Na}$.	$\text{C}_2\text{H}_5\text{O}_2\text{Ag}$.	$\text{C}_2\text{H}_5\text{O}_2\text{Na}$.	$\text{C}_2\text{H}_5\text{O}_2\text{Ag}$.
0	0.0471	0	8.519	0	0.0462	0	8.362
0.0133	0.0415	2.289	7.511	0.0167	0.0393	1.607	7.114
0.0267	0.0379	4.577	6.86	0.0333	0.0345	3.215	6.244
0.0533	0.0307	9.059	5.556	0.0667	0.0258	6.429	4.670
0.100	0.0222	16.997	4.019	0.1333	0.0191	12.859	3.456
				0.2667	0.0131	25.718	2.371
				0.5000	0.0101	48.77	1.828

SOLUBILITY OF SILVER PROPIONATE IN AQUEOUS SOLUTIONS OF PROPIONIC ACID
AT 25° . (Knox and Will, 1919.)

Gm. equiv. $\text{C}_2\text{H}_5\text{COOH}$ per liter.	Gms. $\text{C}_2\text{H}_5\text{COOAg}$ per liter.	Gm. equiv. $\text{C}_2\text{H}_5\text{COOH}$ per liter.	Gm. $\text{C}_2\text{H}_5\text{COOAg}$ per liter.	Gm. equiv. $\text{C}_2\text{H}_5\text{COOH}$ per liter.	Gms. $\text{C}_2\text{H}_5\text{COOAg}$ per liter.
0.00	9.04	2.97	7.60	8.56	4.96
1.00	8.58	4.95	6.78	11.40	3.16
2.00	8.01	6.98	5.78	13.03	3.17

SILVER Acetal PROPIONATE (LEVULINATE) $\text{Ag} \cdot \text{CH}_3\text{COCH}_2\text{CH}_2\text{COO}$.

SOLUBILITY IN WATER.

(Furcht and Lieben, 1909.)

t°.	Gms. per 100 Gms. Sat. Solution.	
	o.5363 (white salt)	o.5195 (yellow salt)
8	o.5166	o.5372
9	o.6078	o.6448
14-15	3.49	3.70
99.6		

SILVER BUTYRATE $\text{C}_4\text{H}_7\text{COOAg}$.

SILVER (Iso)BUTYRATE $(\text{CH}_3)_2\text{CHCOOAg}$.

SOLUBILITY OF EACH SEPARATELY IN WATER.

(Goldschmidt, 1898; Arrhenius, 1893; Reupenstrauch, 1885, Fühner, 1924.)

t°.	Gms. per 100 Gms. H ₂ O.		t°.	Gms. per 100 Gms. H ₂ O.	
	Butyrate.	Iso Butyrate.		Butyrate.	Iso Butyrate.
0	o.363	o.796	30	o.561	1.060 (1.1022)
10	o.419	o.874	40	o.647	1.176 (R.)
17.8	o.432 (A.)	...	50	o.742	1.313
18.8	o.445 (A.)	...	60	o.848	...
20	o.484	o.961 (o.9986)	70	o.964	1.670
25	...	... (1.0442)	80	1.14	1.898

CH

SOLUBILITY OF SILVER BUTYRATE IN AQ. SOLUTIONS OF SILVER ACETATE, SILVER NITRATE AND OF SODIUM BUTYRATE.

(Arrhenius, 1893.)

In Silver Acetate at 17.8°.

G. Mols. per Liter.*		Grams per Liter.	
CH_3COOAg .	$\text{C}_4\text{H}_7\text{COOAg}$.	CH_3COOAg .	$\text{C}_4\text{H}_7\text{COOAg}$.
o.o	o.0221	o.o	4.32
o.o270	o.o139	4.51	2.71
o.o506	o.o103	8.45	2.01

In Silver Nitrate at 18.8°.

G. Mols. per Liter.		Grams per Liter.	
AgNO_3 .	$\text{C}_4\text{H}_7\text{COOAg}$.	AgNO_3 .	$\text{C}_4\text{H}_7\text{COOAg}$.
o.o	o.0228	o.o	4.445
o.o667	o.o078	11.33	1.521
o.100	o.o062	17.00	1.209

In Sodium Butyrate at 18.2°.

G. Mols. per Liter.		Grams per Liter.		G. Mols. per Liter.		Grams per Liter.	
$\text{C}_4\text{H}_7\text{COONa}$.	$\text{C}_4\text{H}_7\text{COOAg}$.	$\text{C}_4\text{H}_7\text{COONa}$.	$\text{C}_4\text{H}_7\text{COOAg}$.	$\text{C}_4\text{H}_7\text{COONa}$.	$\text{C}_4\text{H}_7\text{COOAg}$.	$\text{C}_4\text{H}_7\text{COONa}$.	$\text{C}_4\text{H}_7\text{COOAg}$.
o.o	o.0224	o.o	4.363	o.o658	o.o091	7.24	1.774
o.o066	o.o199	o.73	3.881	o.1315	o.o060	14.47	1.170
o.o164	o.o169	1.81	3.296	o.263	o.o040	28.96	o.780
o.o329	o.o131	3.62	2.555	o.493	o.o027	54.28	o.526

SILVER FUMARATE $\text{C}_4\text{H}_2\text{O}_4\text{Ag}_2$

100 gms H_2O dissolve o.o13 gm. silver fumarate at 30°. (Weiss and Downs, 1923.)

SILVER MALEATE $\text{C}_4\text{H}_2\text{O}_4\text{Ag}_2$

100 gms. H_2O dissolve o.12 gm. silver maleate at 30°. (Weiss and Downs, 1923.)

SILVER MALATE $C_4H_4O_6Ag_2$.

100 gms. H_2O dissolve 0.0119 gms. at 18° . and 0.1216 gm. at 25° .
(Partheil and Hübner, 1903.)

SILVER TARTRATE $C_4H_4O_6Ag_2$.

100 gms. H_2O dissolve 0.2012 gm. $C_4H_4O_6Ag_2$ at 18° , and 0.2031 gm. at 25° .
(Partheil and Hübner, 1903.)

SOLUBILITY OF SILVER TARTRATE IN WATER AND IN AQUEOUS SOLUTIONS OF
BORIC ACID AT 18° . (Kolthoff, 1926.)

Solvent.	Normality of sat. sol. in Ag ions.	Gms. $C_4H_4O_6Ag_2$ per liter.
Water.....	0.0086	1.42
Aq. 0.1 mol. H_3BO_3	0.00148 (?)	2.45 (?)
» 0.5 » »	0.0414	6.87

The above gram quantities were calculated by multiplying the normality of Ag ions by one-half the molecular weight of silver tartrate.

SILVER SUCCINATE $C_4H_4O_4Ag_2$.

CH

100 gms. H_2O dissolve 0.0176 gm. at 18° , and 0.0199 gm. at 25° .
(Partheil and Hübner, 1903.)

SILVER β Methyl ADIPATE (Neutral Salt).

100 cc. sat. solution of silver β methyl adipate in water contain 0.12 gm. of the compound at 20° .
(Meurisse.)

SILVER VALERATES $AgC_5H_9O_2$.

Normal Valerate, $CH_3(CH_2)_3COOAg$. Iso Valerate, $CH_3CH(CH_3)_2CH_2COOAg$.

SOLUBILITY OF EACH SEPARATELY IN WATER.

(Fürth, 1888; Sedlitzky, 1887.)

t°.	Gms. per 100 Gms. H_2O .		t°.	Gms. per 100 Gms. H_2O .	
	Normal V.	Iso V.		Normal V.	Iso V.
0	0.229	0.177	50	0.474	0.360
10	0.259	0.211	60	0.552	0.401
20	0.300	0.246	70	0.636	0.443
30	0.349	0.283	80	...	0.486
40	0.408	0.321			

100 gms. H_2O dissolve 0.73 gm. silver valerate at 20° . (Markwald, 1899.)

100 cc. sat. aq. solution contains 0.71 gm. dextro silver valerate at 15° .

(Taverné, 1900.)

100 gms. H_2O dissolve 0.476 gms. η $CH_3(CH_2)_3COOAg$ at 50° .

(Fühner, 1924.)

**SOLUBILITY OF SILVER VALERATE IN AQUEOUS SOLUTIONS OF SILVER
ACETATE, SILVER NITRATE AND OF SODIUM VALERATE.**
(Arrhenius, 1893.)

In Silver Acetate at 17.8°.

Mols. per Liter.		Gms. per Liter.	
$C_2H_3O_2Ag.$	$C_5H_9O_2Ag.$	$C_2H_3O_2Ag.$	$C_5H_9O_2Ag.$
0	0.0094	0	1.96
0.0067	0.0070	1.13	1.46
0.0135	0.0057	2.27	1.19
0.0270	0.0037	4.54	0.77
0.0505	0.00265	8.48	0.55

In Silver Nitrate at 16.5°.

Mols. per Liter.		Gms. per Liter.	
$AgNO_3.$	$C_5H_9O_2Ag.$	$AgNO_3.$	$C_5H_9O_2Ag.$
0	0.0094	0	1.96
0.0067	0.0068	1.14	1.42
0.0133	0.0051	2.29	1.07
0.0267	0.0031	4.58	0.65
0.1000	0.0012	17.	0.25

In Sodium Valerate at 18.6°.

Mols. per Liter.		Gms. per Liter.	
$C_5H_9O_2Na.$	$C_5H_9O_2Ag.$	$C_5H_9O_2Na.$	$C_5H_9O_2Ag.$
0	0.0095	0	1.986
0.0175	0.0047	2.17	0.982
0.0349	0.0030	4.32	0.627
0.0698	0.0018	8.65	0.376
0.1395	0.0015	17.31	0.313

SILVER CAPROATES $Ag(C_6H_{11}O_2).$ (Silver hexanoates)

SOLUBILITY OF EACH SEPARATELY IN WATER.

(Keppish, 1888; Stiassny, 1891; Kulisch, 1893; König, 1894; Altschul, 1896.)

Results in terms of gms. salt per 100 gms. H_2O .

t°.	Normal Caproate $CH_3(CH_2)_4COOAg.$		2 Methyl Pentan 4 Acid $CH_3CH(CH_3)_2CH_2COOAg.$	Methyl 3 Pentan Acid 4 $CH_3CH_2CH_2CH_2COOAg.$	4 Methyl Pentan Acid 4 $CH_3(CH_2)_2CH(CH_3)_2COOAg.$
0	0.076 (A.)	0.078 (Keppish)	0.168 (König)	0.880 (Kulish)	0.510 (Stiassny)
10	0.085	0.089	0.162	0.858	0.528
20	0.100	0.107	0.163	0.849	0.550
30	0.123	0.131	0.170	0.854	0.574
40	0.154	0.161	0.183	0.871	0.602
50	0.193	0.198	0.203	0.902	0.632
60	0.240	0.243	0.229	0.946	0.666
70	0.295	0.288	0.263	1.003	0.702
80	0.354	...	0.300	1.073	0.742
90	...	...	0.347	1.157	...

100 gms. H_2O dissolve 0.193 gm. \bar{n} silver caproate, $Ag C_5H_{11}COO$, at 50°.
(Fuhner, 1924.)

SILVER CITRATE $C_6H_5O_7Ag_3.$

100 gms. H_2O dissolve 0.0277 gm. $C_6H_5O_7Ag_3$ at 18°, and 0.0284 gm. at 25°.
(Partheil and Hübner, 1903.)

SILVER Nitroso β PHENYL HYDROXYLAMINE. $Ag[C_6H_5 \cdot N(NO)O].$

The solubility in water of the precipitated silver salt of nitroso phenylhydroxylamine obtained by adding a solution of "cupferron" ($C_6H_5 \cdot N(NO)O \cdot NH_4$), to a solution of a soluble silver salt, was determined at 18° by potentiometric and conductometric methods. The results showed $1.4 \cdot 10^{-3}$ gm. atoms Ag per liter, equivalent to 0.150 gm. $Ag C_6H_5N(NO)O$ (Pinkus and Martin, 1927.)

SILVER BENZOATE $\text{Ag}[\text{C}_6\text{H}_5\text{COO}]$.

SOLUBILITY OF SILVER BENZOATE IN WATER

t°	Gm. Mol. $\text{Ag}[\text{C}_6\text{H}_5\text{COO}]$ per liter	Gms. $\text{Ag}[\text{C}_6\text{H}_5\text{COO}]$ per liter	Authority
14.5	—	1.763	(Holleman, 1893.)
18.0	0.01038	2.375	(Larson and Adel, 1931.)
20.0	—	2.17	(Ephraim and Pfister, 1925.)
25.0	0.01144	2.61	(Noyes and Schwartz, 1898.)
25.0	0.01162	2.66	(Kolthoff and Bosch, 1932.)

SOLUBILITY OF SILVER BENZOATE AT 25° IN AQUEOUS SOLUTIONS OF:
(Noyes and Schwartz, 1898.)

CH

Nitric Acid				Chloracetic Acid			
Gms. Mols. per Liter.		Gms. per Liter.		Gms. Mols. per Liter.		Gms. per Liter.	
HNO_3 .	$\text{C}_6\text{H}_5\text{COOAg}$.	HNO_3 .	$\text{C}_6\text{H}_5\text{COOAg}$.	CH_3ClCOOH .	$\text{C}_6\text{H}_5\text{COOAg}$.	CH_3ClCOOH .	$\text{C}_6\text{H}_5\text{COOAg}$.
0	0.01144	0	2.607	0	0.01144	0	2.607
0.004435	0.01395	0.280	3.195	0.00394	0.01385	0.371	3.172
0.00887	0.01698	0.559	3.889	0.00787	0.01612	0.744	3.691
0.00892	0.01715	0.562	3.926	0.01574	0.02093	1.487	4.792
0.01774	0.02324	1.118	5.321				
0.02674	0.03071	1.686	7.031				

One liter of cold alcohol dissolves 0.169 gm. $\text{C}_6\text{H}_5\text{COOAg}$; one liter of boiling alcohol dissolves 0.465 gm. (Liebermann, 1902.)

SOLUBILITY AT 18° OF SILVER BENZOATE IN AQUEOUS SOLUTIONS OF:
(Larson and Adel, 1931.)

Sodium Nitrate		Potassium Nitrate		Barium Nitrate		Sodium Acetate	
Gm. Mols. per liter		Gm. Mols. per liter		Gm. Mols. per liter		Gm. Mols. per liter	
NaNO_3	$\text{Ag C}_6\text{H}_5\text{COO}$	KNO_3	$\text{Ag C}_6\text{H}_5\text{COO}$	$\text{Ba}(\text{NO}_3)_2$	$\text{Ag C}_6\text{H}_5\text{COO}$	$\text{Na CH}_3\text{COO}$	$\text{Ag C}_6\text{H}_5\text{COO}$
0.0	0.01038	0.05	0.01172	0.0	0.01038	0.0	0.01038
0.10	0.01215	0.10	0.01221	0.06	0.01214	0.0099	0.01055
0.30	0.01351	0.30	0.01363	0.08	0.01235	0.0496	0.01196
0.50	0.01422	0.50	0.01424	0.125	0.01306	0.0992	0.01303
1.00	0.01523	0.80	0.01476	0.160	0.01323	0.2974	0.01608
2.00	0.01624	1.00	0.01507	0.20	0.01366		
3.00	0.01610	2.00	0.01593				
		3.00	0.01576				

FERROUS SULFITE $\text{FeSO}_3 \cdot 5\text{H}_2\text{O}$ EQUILIBRIUM IN THE SYSTEM FERROUS OXIDE, SULFUR
DIOXIDE AND WATER AT 15° AND AT 25° .

(Terres and Ruhl, 1934.)

The determinations were made by the synthetic method. The authors give a diagram in the present paper but the numerical results are published only in their report in *Beihette zu den Zeitschriften des Vereines deutscher Chemiker* No. 8 1934 - Verlag chemie Berlin W 35 Cornelius str 3. Estimating from the small diagram the following approximate values were obtained.

Results at 15°

Mol. percent in sat. sol.	
FeO	SO_2

Solid Phase

0.5	0.3	$\text{FeSO}_3 \cdot 5\text{H}_2\text{O} (?)$
1.0	0.6	"
2.0	1.2	"
2.5	1.4	" + $\text{Fe}(\text{HSO}_3)_2 (?)$
2.4	2.0	$\text{Fe}(\text{HSO}_3)_2 (?)$
2.2	3.5	"
2.3	5.0	"
2.6	7.0	"
3.0	8.1	"

Results at 25°

Mol. percent in sat. sol.	
FeO	SO_2

Solid Phase

0.5	0.75	$\text{FeSO}_3 \cdot 5\text{H}_2\text{O}$
1.0	1.3	"
1.5	1.6	"
1.9	2.0	" + $\text{Fe}(\text{HSO}_3)_2 (?)$
1.5	2.9	$\text{Fe}(\text{HSO}_3)_2 (?)$
1.25	4.0	"
1.5	5.9	"
2.0	7.6	"
2.3	8.3	"

SO

The mixtures separated into two liquid layers at concentrations of SO_2 between 8.5 and 93 Mol. percent.

IRON SULFATE (Ferrous) $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$.

SOLUBILITY OF FERROUS SULFATE IN WATER. (Fraenckel, 1907.)

t°	Gms. FeSO_4 per 100 Gms. H_2O	Solid Phase.	t°	Gms. FeSO_4 per 100 Gms. H_2O	Solid Phase.
-0.172	1.0156	Ice	45.18	44.32	$\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$
-0.566	4.2852	"	50.21	48.60	"
-1.063	8.7054	"	52	50.20	"
-1.511	12.713	"	54.03	52.07	"
-1.771	14.511	"	56.56 tr. pt.	54.58	" + $\text{FeSO}_4 \cdot 4\text{H}_2\text{O}$
-1.82 Eutec.	17.53	Ice + $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$	60.01	54.95	$\text{FeSO}_4 \cdot 4\text{H}_2\text{O}$
0	15.65	$\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$	65	55.59	" unstable
+10	20.51	"	70.04	56.08	" "
15.25	23.86	"	64.8 tr. pt.	...	$\text{FeSO}_4 \cdot 4\text{H}_2\text{O}$ + $\text{FeSO}_4 \cdot \text{H}_2\text{O}$
20.13	26.56	"	68.02	52.31	$\text{FeSO}_4 \cdot \text{H}_2\text{O}$
25.02	29.60	"	77	45.90	"
30.03	32.93	"	80.41	43.58	"
35.07	36.87	"	85.02	40.46	"
40.05	40.20	"	90.13	37.27	"

 $d_{16.6}$ of sat. sol. = 1.219¹

(Greenish and Smith, 1903.)

SOLUBILITY OF FERROUS SULFATE IN WATER.

(Agde and Barkholt, 1926.)

t°	d of sat. sol.	Gms. $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$ per 100 gms. sat. sol.	t°	d of sat. sol.	Gms. $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$ per 100 gms. sat. sol.
1.0.....	1.140	25.25	34.0.....	1.312	48.65
9.6.....	1.178	31.32	43.0.....	1.363	55.01
21.0.....	1.233	39.02	54.0.....	1.432	63.18
25.0... ..	1.255	42.08	80.0.....	1.367	55.49

Fe FERRUM

540

SOLUBILITY OF FERRIC SULFATE IN AQUEOUS SOLUTIONS
OF FERROUS SULFATE AT 25° AND AT 50°.

(Cameron, 1936.)

The mixtures were agitated for seven months.

Results at 25°

Results at 50°

Gms. per 100 gms. sat. sol.			Solid Phase	Gms. per 100 gms. sat. sol.			Solid Phase
FeSO ₄	Fe ₂ (SO ₄) ₃	Excess SO ₄		FeSO ₄	Fe ₂ (SO ₄) ₃	Excess SO ₄	
0.38	44.75	1.48	B.F.S.	0.19	48.73	0.78	B.F.S.
0.82	44.15	1.93	"	0.67	46.54	2.59	"
1.36	43.79	3.19	"	3.67	44.50	1.33	"
2.01	43.32	2.98	"	6.18	41.03	3.16	" + FeSO ₄ ·7H ₂ O
2.61	43.25	1.12	"	8.02	38.87	5.20	"
3.07	42.60	1.56	" + FeSO ₄ ·7H ₂ O	10.55	36.61	2.50	"
5.30	38.42	3.61	"	14.74	32.94	1.09	FeSO ₄ ·7H ₂ O
8.16	36.60	1.90	Fe ₂ (SO ₄) ₃ + "	19.40	25.35	0.95	"
10.47	28.36	0.25	"	21.76	19.85	1.01	"
15.23	16.64	0.04	"	27.88	9.67	0.22	"
20.24	5.73	0.21	"	30.35	5.40	0.30	"
22.50	1.36	0.63	"	31.99	2.79	0.67	"

B.F.S. = Basic Ferric Sulfate. At concentrations of FeSO₄ less than 8.16 percent at 25° and 14.74 percent at 50° the nature of the solid phase is uncertain.

SO

SOLUBILITY OF FERROUS SULFATE IN AQUEOUS SOLUTIONS OF
SULFURIC ACID AT VARIOUS TEMPERATURES.

(Cameron, 1930.)

Gms. per 100 gms. sat. sol.			Solid Phase	Gms. per 100 gms. sat. sol.			Solid Phase	Gms. per 100 gms. sat. sol.			Solid Phase
H ₂ SO ₄	FeSO ₄	H ₂ SO ₄		FeSO ₄	H ₂ SO ₄	FeSO ₄					
Results at 0°				Results at 25° Con.				Results at 65°			
1.81	14.1	Fe ₇		27.78	10.70	Fe ₇ + Fe ₁		1.82	34.24	Fe ₄	
4.10	13.8	"		31.00	8.50	Fe ₁		1.61	34.66	"	
8.45	11.10	"		35.66	5.89	"		3.29	32.57	Fe ₂	
15.56	8.93	"		41.47	3.07	"		10.21	25.11	"	
17.76	7.67	"		45.70	1.75	"		16.32	20.48	"	
25.98	4.80	"		54.71	0.97	"		29.46	10.38	"	
32.50	3.99	"		60.23	0.56	"		Results at 75°			
36.05	3.64	"		64.35	0.40	"					
38.62	3.38	" + Fe ₁		Results at 55°							
41.80	2.34	Fe ₁						0.43	31.46	Fe ₂	
53.25	0.55	"						3.45	28.00	"	
63.60	0.28	"		1.74	33.48	Fe ₇		5.60	25.58	"	
Results at 25°				2.43	32.76	"		8.71	22.60	"	
				3.87	31.91	"		10.78	21.29	"	
				5.93	29.20	Fe ₁		21.90	14.40	"	
1.13	22.88	Fe ₇		7.73	26.87	"		27.72	11.26	"	
3.41	20.64	"		11.44	24.34	"		34.72	7.05	"	
6.32	18.67	"		22.26	15.42	"		Fe ₇ = FeSO ₄ ·7H ₂ O			
9.37	16.79	"		31.30	9.25	"		Fe ₄ = FeSO ₄ ·4H ₂ O			
13.00	15.56	"		45.37	3.03	"		Fe ₂ = FeSO ₄ ·2H ₂ O			
17.34	13.25	"		56.49	1.01	"		Fe ₁ = FeSO ₄ ·H ₂ O			
24.54	11.23	"		69.20	0.61	"					

The author also gives a review of the literature pertaining to the properties of ferrous sulfate, especially its solubility in presence of other salts.

SOLUBILITY OF FERRIC SULFATE AND OF FERROUS SULFATE IN AQ.
SOLUTIONS OF SULFURIC ACID AT 25°. (Wirth, 1912-13.)

Results for Ferric Sulfate.

Normality of used Acid.	Gms. per 100 Gms. Sat. Sol.	
	Fe ₂ O ₃	Fe ₂ (SO ₄) ₃
2.25	9.99	25.02
6.685	5.82	14.58
19.84	0.02	0.05

Results for Ferrous Sulfate.

Normality of used Acid.	Gms. per 100 Gms. Sat. Sol.		Solid Phase.
	Fe ₂ O ₃	FeSO ₄	
2.25	10	19.03	FeSO ₄ ·7H ₂ O
10.2	5.414	10.30	"
12.46	3.816	7.26	FeSO ₄ ·H ₂ O
15.15	2.11	4.015	"
19.84	0.08	0.1522	"

EQUILIBRIUM IN THE SYSTEM FERRIC OXIDE, SULFURIC ACID AND WATER AT 25°.
(Cameron and Robinson, 1907.)

(Excess of freshly precipitated ferric hydroxide was added to ferric sulfate solutions of varying concentrations and the mixtures constantly shaken for 4 months.)

d ₂₅ of Sat. Sol.	Gms. per 100 Gms. Sat. Sol.		Solid Phase.	Gms. per 100 Gms. Sat. Sol.		Solid Phase.
	Fe ₂ O ₃	SO ₃		Fe ₂ O ₃	SO ₃	
1.001	0.07	0.11	Solid Solution	20.48	26.18	Fe ₂ O ₃ ·3SO ₃ ·10H ₂ O
1.011	0.62	0.94	"	19.77	28.93	"
1.045	2.03	2.65	"	10.87	31.35	Fe ₂ O ₃ ·4SO ₃ ·10H ₂ O
1.131	6.18	7.40	"	0.16	35.96	"
1.217	10.03	11.84	"	0.07	41.19	"
1.440	15.90	20.70	"	1.05	42.43	"

SO

EQUILIBRIUM IN THE SYSTEM FERRIC OXIDE, SULFURIC ACID AND WATER.
(Koerker and Calderwood, 1938.)

Weighed samples were agitated in sealed glass bottles for various lengths of time and allowed to settle. The liquid and solid were separated by filtration using a fritted glass filter. This required considerable time and the operation was conducted in the constant temperature bath. Both the filtrates and the moist solids were analyzed.

Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase
Fe ₂ O ₃	SO ₃		Fe ₂ O ₃	SO ₃	

Results at 10°			Results at 15° (con.)		
2.76	4.12	SS	14.20	28.25	Fe ₂ O ₃ ·3SO ₃
7.32	12.59	"	17.11	31.01	" 18H ₂ O
16.30	25.88	"	18.75	31.94	"
2.23	16.19	Fe ₂ O ₃ + 2.44SO ₃	17.75	31.85	"
6.70	31.27	+ 8.65H ₂ O	10.30	30.90	Fe ₂ O ₃ ·4.46SO ₃
0.0	37.23	SS	7.25	32.31	" 19.2H ₂ O
0.4	45.00	"	2.48	35.23	"
0.27	48.40	"	0.80	36.40	"
0.41	50.10	"	0.01	37.20	"
0.04	74.50	"	3.59	30.60	Fe ₂ O ₃ ·5.84SO ₃
			0.77	34.80	" 30H ₂ O?
			0.01	37.20	"
			7.02	29.39	"
			0.98	30.32	"
			13.18	32.84	Fe ₂ O ₃ ·3.33SO ₃
			10.04	33.21	" 10.3H ₂ O
			2.48	35.23	"
			0.80	36.40	"
			0.01	9.33	"
			14.09	33.80	"
			15.65	42.27	"

Results at 15°		
12.46	16.60	SS
14.61	21.23	"
15.70	23.05	"
16.63	24.00	"
17.61	26.45	"
16.10	25.40	Fe ₂ O ₃ ·3SO ₃ ·18H ₂ O
15.86	24.98	"
14.47	26.15	"

* Supersaturated, SS = Solid Solution

EQUILIBRIUM IN THE SYSTEM FERRIC OXIDE, SULFURIC ACID AND WATER

(Appleyby and Wilkes, 1922.)

Results at 18°.

Gms. per 100 gms. sat. sol.		Solid Phase.
Fe ₂ O ₃ .	SO ₃ .	
0.21	40.64	Fe ₂ O ₃ .4SO ₃ .9H ₂ O
0.91	36.45	"
6.48	32.43	"
8.00	31.85	"
9.63	31.88	" + Fe ₂ O ₃ .3SO ₃ .7H ₂ O
11.69	30.80	Fe ₂ O ₃ .3SO ₃ .7H ₂ O
13.88	29.71	"
17.48	29.73	"
18.68	29.64	" + Basic solid solut.
17.96	25.42	Basic solid solutions
14.00	17.71	"
11.60	13.85	"
6.81	7.60	"

Results at 23°.

Gms. per 100 gms. sat. sol.		Solid Phase.
Fe ₂ O ₃ .	SO ₃ .	
0.27	39.77	Fe ₂ O ₃ .4SO ₃ .9H ₂ O
0.71	37.22	"
2.38	34.99	"
3.88	33.20	"
8.04	32.06	Fe ₂ O ₃ .3SO ₃ .7H ₂ O
10.55	30.77	"
13.80	30.02	"
17.52	29.85	.5(Fe ₂ O ₃ .3SO ₃).2Fe ₂ O ₃
18.56	29.98	"
19.98	29.19	Basic solid solutions
19.78	27.90	"
19.55	25.99	"
15.53	17.62	"
13.51	14.58	"
7.91	8.19	"

EQUILIBRIUM IN THE SYSTEM FERRIC OXIDE, SULFURIC ACID AND WATER
AT 50° TO 200°. (Posnjak and Mervin, 1922.)

SO

The authors give a critical discussion of previous work on this system. Their own determinations were made with the greatest possible accuracy. The identification of the solid phases was made both microscopically and analytically. Sealed tubes were used and at temperatures above 50° the tubes were heated by means of a resistance furnace within a steel bomb. The time required for equilibrium varied from 2 months at 50° to only a week or 10 days at the higher temperatures.

Results for the Isotherm at 50°.

Gms. per 100 gms. sat. sol.		Solid Phase.	Gms. per 100 gms. sat. sol.		Solid Phase.
Fe ₂ O ₃ .	SO ₃ .		Fe ₂ O ₃ .	SO ₃ .	
0.14	0.39	Fe ₂ O ₃ .H ₂ O	20.70	28.40	2Fe ₂ O ₃ .5SO ₃ .17H ₂ O
0.39	0.79	"	16.78	30.72	" + Fe ₂ O ₃ .3SO ₃ .7H ₂ O
0.90	1.53	"	10.26	31.91	Fe ₂ O ₃ .3SO ₃ .7H ₂ O
1.44	2.30	" + 3Fe ₂ O ₃ .3SO ₃ .9H ₂ O (?)	8.56	32.52	"
2.55	4.08	3Fe ₂ O ₃ .4SO ₃ .9H ₂ O	5.55	33.96	Fe ₂ O ₃ .4SO ₃ .9H ₂ O
5.71	9.09	"	0.34	41.18	"
7.19	11.19	"	0.10	48.44	"
15.43	20.08	"	0.09	55.34	"
16.09	20.81	"	0.07	59.20	Fe ₂ O ₃ .4SO ₃ .3H ₂ O
17.96	22.96	" + Fe ₂ O ₃ .2SO ₃ .5H ₂ O	0.08	62.34	"
20.13	27.18	Fe ₂ O ₃ .2SO ₃ .5H ₂ O	0.07	75.37	"

Similar data for the 75°, 110°, 140° and 200° isotherms are given and also several determinations at 130°, 150° and 300°.

The following supplementary determinations upon this system at 50° are given by Tunell and Posnjak, 1931.

Gms. per 100 gms. sat. sol.			Solid Phase
Fe ₂ O ₃	SO ₃	H ₂ O	
0.01	0.10	99.89	Fe ₂ O ₃ .H ₂ O
1.95	2.94	95.11	" + 3Fe ₂ O ₃ .4SO ₃ .9H ₂ O
2.54	3.57	93.89	"

EQUILIBRIUM IN THE SYSTEM FERRIC OXIDE, SULFUR
SULFUR TRIOXIDE AND WATER AT 25°.

(Baskerville and Cameron, 1935.)

Many series of determinations were made upon mixtures prepared in different ways and agitated for various lengths of time. For periods of as long as a year. The limiting members of the solid solutions appeared to be ferric oxide on the one hand and on the other a compound approaching the composition $\text{Fe}_2\text{O}_3 \cdot 2.5\text{SO}_3 \cdot 7\text{H}_2\text{O}$.

d. of sat. sol.	Gms. per 100		Solid Phase	Gms. per 100		Solid Phase	Gms. per 100		Solid Phase
	gms. sat. Fe_2O_3	sol. SO_3		gms. sat. Fe_2O_3	sol. SO_3		gms. sat. Fe_2O_3	sol. SO_3	
1.052	2.45	3.55	SS	15.10	29.14	1.22.7	6.96	32.06	1.4.9
1.104	4.86	6.83	"	15.94	28.88	"	4.70	32.68	"
1.229	9.86	12.55	"	16.70	28.00	"	2.03	34.33	"
1.242	10.19	12.98	"	17.31	27.45	"	0.26	38.72	"
1.328	12.33	18.17	"	18.21	26.85	"	0.03	56.79	"
1.397	15.52	19.21	"	19.06	26.77	"	8.4	31.8*	" + 1.3.8
1.500	17.19	23.96	"	16.4	28.2	" + 1.3.9	10.34	30.96	1.3.8
1.471	16.67	24.67	"	14.49	28.28	1.3.9	8.94	31.54	"
1.550	19.08	25.22	"	12.18	28.88	"	14.7	30.3*	" + 1.2.5.7
1.590	17.95	28.95	"	11.06	28.92	"	8.11	31.88	1.4.9
—	20.5	26.4	" + 1.22.7	9.31	29.64	"	7.96	31.86	"
				7.2	32.1	" + 1.4.9			

* Metastable

1.22.7 = $\text{Fe}_2\text{O}_3 \cdot 2.5\text{SO}_3 \cdot 7\text{H}_2\text{O}$; 1.3.9 = $\text{Fe}_2\text{O}_3 \cdot 3\text{SO}_3 \cdot 9\text{H}_2\text{O}$; 1.4.9 = $\text{Fe}_2\text{O}_3 \cdot 4\text{SO}_3 \cdot 9\text{H}_2\text{O}$; 1.3.8 = $\text{Fe}_2\text{O}_3 \cdot 3\text{SO}_3 \cdot 8\text{H}_2\text{O}$; SS = Solid Solution

SO

EQUILIBRIUM IN THE SYSTEM FERRIC OXIDE-SULFUR TRIOXIDE-WATER AT 25°.
(Wirth and Bakke, 1914.)

(The mixtures were shaken for 3-4 weeks.)

Gms. per 100 Gms. Sat. Sol.		Solid Phase.	Gms. per 100 Gms. Sat. Sol.		Solid Phase.
Fe_2O_3	SO_3		Fe_2O_3	SO_3	
...	71.23	not det.	14.49	31.45	unstable
0.24	56.84	"	15.71	31.88	"
3.53	34	{ prob. $\text{Fe}_2(\text{SO}_4)_3 \cdot \text{H}_2\text{SO}_4 \cdot 9\text{H}_2\text{O}$ + $\text{Fe}_2(\text{SO}_4)_3 \cdot \text{H}_2\text{SO}_4 \cdot 3\text{H}_2\text{O}$	20.21	31.30	"
6.65	32.15		9.39	31.54	{ $\text{Fe}_2(\text{SO}_4)_3 \cdot \text{H}_2\text{SO}_4 \cdot 8\text{H}_2\text{O}$ + $\text{Fe}_2(\text{SO}_4)_3 \cdot 9\text{H}_2\text{O}$
9.39	31.54	" + $\text{Fe}(\text{SO}_4)_3 \cdot \text{H}_2\text{SO}_4 \cdot 3\text{H}_2\text{O}$	11.06	29.43	$\text{Fe}_2(\text{SO}_4)_3 \cdot 9\text{H}_2\text{O}$
12.03	31.51	$\text{Fe}(\text{SO}_4)_3 \cdot \text{H}_2\text{SO}_4 \cdot 8\text{H}_2\text{O}$	13.88	28.33	"
13.27	31.84	"	15.23	27.92	"
13.68	31.78	unstable	16.07	27.98	"

Results are also given for the two forms of yellow ferric sulfate (α copiapite and β copiapite) also for ferric hydroxide and sulfate solutions.

It was found that a saturated solution of $\text{Fe}_2(\text{SO}_4)_3 \cdot \text{H}_2\text{SO}_4 \cdot 8\text{H}_2\text{O}$ in abs. alcohol at 25° contained 8 gms. Fe_2O_3 + 17.18 gms. SO_3 (Ratio, 1:4.235) per 100 gms. sat. sol.

The yellow ferric sulfate $\text{Fe}_2(\text{SO}_4)_3 \cdot 9\text{H}_2\text{O}$ is less soluble in alcohol. After 4 weeks shaking at 25°, 100 gms. of the sat. solution in abs. alcohol contained 4.497 gms. Fe_2O_3 and 6.779 gms. SO_3 (Ratio, 1:3.006). Thus the alcoholic solution, just as the aqueous, is considerably more acid than the solid phase with which it is in equilibrium.

100 grams sat. solution in glycol contain 6 gms. FeSO_4 at ordinary temperature.

(de Coninck.)

100 gms. anhydrous hydrazine dissolve 1 gm. ferrous sulfate at room temp. with decomposition.

(Welsh and Broderson, 1915.)

FERROUS SULFATE

Freezing-point data for mixtures of ferrous sulfate and 100 per cent sulfuric acid are given by Kendall and Davidson, 1921.

FERRIC SULFATE

SOLUBILITY OF FERRIC SULFATE IN AQUEOUS SOLUTIONS OF POTASSIUM SULFATE AT 25° AND VICE VERSA.

(Cameron, 1936.)

Gms. per 100	gms. sat. sol.	Solid	Gms. per 100	gms. sat. sol.	Solid
K_2SO_4	$Fe_2(SO_4)_3$	Phase	K_2SO_4	$Fe_2(SO_4)_3$	Phase
2.83	27.8	1.2.14	11.7	0.85	1.2.14 + K_2SO_4
2.94	24.3	"	12.2	1.25*	"
3.34	21.8	"	12.5	1.53*	"
3.38	20.8	"	13.1	1.68*	"
4.56	13.1	"	13.7	1.88*	"
5.43	11.2	"	11.9	0.69	K_2SO_4
5.32	9.02	"	11.8	0.31	"
6.21	6.04	"	11.5	0.10	"
8.0	2.35	"	11.3	0.02	"

* Probably points on a boundary curve of a four component system.

1.2.14 = $Fe_2(SO_4)_3 \cdot 2K_2SO_4 \cdot 14H_2O$

The solutions contained a variable small excess of SO_4

SO FERROUS Potassium SULFATE $FeSO_4 \cdot K_2SO_4 \cdot 6H_2O$.

SOLUBILITY IN WATER. (Tobler, 1855.)

t°.	Gms. $K_2Fe(SO_4)_2$ per 100 Gms. H_2O .	t°.	Gms. $K_2Fe(SO_4)_2$ per 100 Gms. H_2O .
0	19.6	35	41
10	24.5	40	45
14.5	29.1	55	56
16	30.9	65	57.3
25	36.5	70	64.2

FERROUS Potassium SULFATE $FeK_2(SO_4)_2 \cdot 6H_2O$.

SOLUBILITY OF MIXED CRYSTALS OF IRON POTASSIUM SULFATE AND ZINC POTASSIUM SULFATE IN WATER AT 60.8. (Haber-Chuwis, 1926.)

d of sat. sol.	Gms. per 1000 cc. sat. sol.		Mol. per cent $FeK_2(SO_4)_2 \cdot 6H_2O$ in Solid Phase.
	$FeK_2(SO_4)_2 \cdot 6H_2O$.	$ZnK_2(SO_4)_2 \cdot 6H_2O$.	
1.2067	329.15	0.00	100.0
1.1859	275.03	19.39	93.55
1.1758	246.80	28.82	90.08
1.1606	203.22	47.62	81.98
1.1474	173.59	53.07	76.98
1.1339	142.76	63.87	69.45
1.1204	119.46	67.83	64.29
1.1085	87.69	72.46	55.30
1.0993	68.10	77.78	47.22
1.0795	0.00	113.62	0.00

SOLUBILITY OF FERROUS SULFATE IN AQ. SOLUTIONS OF LITHIUM SULFATE AT 30°. AND VICE VERSA. (Schreinemakers, 1910.)

Gms. per 100	Gms. Sat. Sol.	Solid Phase.	Gms. per 100	Gms. Sat. Sol.	Solid Phase.
FeSO ₄ .	Li ₂ SO ₄ .		FeSO ₄ .	Li ₂ SO ₄ .	
24.87	0	FeSO ₄ ·7H ₂ O	15.39	16.80	Li ₂ SO ₄ ·H ₂ O
24.45	4	"	12.68	18.31	"
21.15	5.58	"	5.32	22.15	"
18.79	11.16	"	3.74	23.15	"
16.51	15.81	"	0	25.1	"
16.11	16.50	" + Li ₂ SO ₄ ·H ₂ O			

SOLUBILITY OF FERROUS SULFATE IN AQUEOUS SOLUTIONS OF MANGANESE SULFATE AND VICE VERSA.

(White, 1933.)

Results at 0°

Results at 25°

Gms. per 100	gms. sat. sol.	Solid Phase	Gms. per 100	gms. sat. sol.	Solid Phase
MnSO ₄	FeSO ₄		MnSO ₄	FeSO ₄	
3.07	12.55	Fe·7H ₂ OSS	0.09	23.09	Fe·7H ₂ OSS
5.83	11.44	"	2.55	21.41	"
10.66	9.26	"	6.82	18.94	"
16.52	6.84	"	10.33	16.62	"
19.18	5.69	"	13.57	14.39	"
29.30	1.25	"	24.96	7.78	"
31.28	0.34	"	36.95	1.82	"
31.84	0.14	"	37.83	1.33	" + Mn·5H ₂ OSS
			38.29	0.85	Mn·5H ₂ OSS
			39.39	0.33	"

SO

Fe·7H₂OSS = FeSO₄ Hepta hydrate Solid Solution; Mn·5H₂OSS = MnSO₄ Penta hydrate Solid Solution.

FERRIC Ammonium SULFATE (Alum) (NH₄)₂Fe(SO₄)₄·24H₂O

100 cc. H₂O dissolve 44.15 gms. anhydrous or 124.40 gms. hydrated salt at 25°. Sp. gr. of saturated solution at 15° = 1.203. (Locke, 1909.)

FERROUS Ammonium SULFATE (NH₄)₂Fe(SO₄)₂·6H₂O

SOLUBILITY IN WATER.

(Tobler; at 25°, Locke — Am. Ch. J. 2KK, 459, '01.)

t°.	G. (NH ₄) ₂ Fe(SO ₄) ₂ per 100 g. H ₂ O.	t°.	G. (NH ₄) ₂ Fe(SO ₄) ₂ per 100 g. H ₂ O.	t°.	G. (NH ₄) ₂ Fe(SO ₄) ₂ per 100 g. H ₂ O.
0	12.5	25	25.0 (T)	50	40
15	20.0	25	35.1 (L)	70	52
		40	33.0		

SOLUBILITY OF AMMONIUM SULFATE IN AQUEOUS SOLUTIONS OF FERROUS SULFATE AT 30° AND VICE VERSA.

(Schreinemakers, 1910 a.)

Gms. per 100	Gms. Sat. Solution.	Solid Phase.	Gms. per 100	Gms. Sat. Solution.	Solid Phase.
(NH ₄) ₂ SO ₄ .	FeSO ₄ .		(NH ₄) ₂ SO ₄ .	FeSO ₄ .	
44.27	0	(NH ₄) ₂ SO ₄	8.90	17.64	I.I.6
43.88	0.79	(NH)SO ₄ + I.I.6	6.44	23.59	"
34.24	1.72	I.I.6	5.91	25.24	I.I.6 + FeSO ₄ ·7H ₂ O
19.64	5.70	"	5.24	25.24	FeSO ₄ ·7H ₂ O
16.29	7.95	"	0	24.90	"
11.45	13.13	"			

I.I.6 = (NH₄)₂SO₄·FeSO₄·6H₂O.

Data for the quaternary system (NH₄)₂SO₄ + FeSO₄ + Li₂SO₄ + H₂O at 30° are also given.

IRON Ammonium SULFATE (Ferrous) $\text{Fe}(\text{NH}_4)_2(\text{SO}_4)_2 \cdot 6\text{H}_2\text{O}$.

SOLUBILITY OF MIXED CRYSTALS OF IRON AMMONIUM SULFATE
AND ZINC AMMONIUM SULFATE IN WATER. (Osterseizer, 1926.)

The two salts mix in all proportions. The influence of temperature upon the solubility is insignificant, in that the relation between the solubilities of the two salts does not change with increase of temperature.

Results at 7°.				Results at 8° 5.			
c. of sat. sol.	Gms. per 1000 cc. sat. sol.		Wt. per cent $\text{Fe}(\text{NH}_4)_2(\text{SO}_4)_2$ $\cdot 6\text{H}_2\text{O}$ in Solid Phase.	c. of sat. sol.	Gms. per 1000 cc. sat. sol.		Wt. per cent $\text{Fe}(\text{NH}_4)_2(\text{SO}_4)_2$ $\cdot 6\text{H}_2\text{O}$ in Solid Phase.
	$\text{Fe}(\text{NH}_4)_2$ $\cdot (\text{SO}_4)_2 \cdot 6\text{H}_2\text{O}$	$\text{Zn}(\text{NH}_4)_2$ $\cdot (\text{SO}_4)_2 \cdot 6\text{H}_2\text{O}$			$\text{Fe}(\text{NH}_4)_2$ $\cdot (\text{SO}_4)_2 \cdot 6\text{H}_2\text{O}$	$\text{Zn}(\text{NH}_4)_2$ $\cdot (\text{SO}_4)_2 \cdot 6\text{H}_2\text{O}$	
1.1541	279.49	0.00	100.0	1.1578	286.52	0.00	100.0
1.1454	236.84	18.99	85.17	1.1452	243.71	24.00	87.12
1.1392	220.24	22.47	76.57	1.1366	212.66	34.99	71.40
1.1377	181.49	40.10	59.99	1.1304	183.13	45.93	56.76
1.1203	158.60	46.88	49.52	1.1184	157.54	54.60	49.51
1.1115	125.20	62.89	37.74	1.1121	133.70	63.35	38.42
1.1051	101.64	70.93	29.51	1.1035	103.70	72.95	27.46
1.0965	73.58	82.46	18.19	1.0963	78.82	81.59	18.63
1.0912	54.36	92.10	13.18	1.0891	53.45	95.04	11.56
1.0794	0.00	125.50	0.00	1.0875	27.65	112.25	5.78
				1.0798	0.00	128.30	0.00

FERRIC SULFATE

SO

SOLUBILITY OF FERRIC SULFATE IN AQUEOUS SOLUTIONS
OF AMMONIUM SULFATE AT 25°.

(Cameron, 1936.)					
Gms. per 100	gms. sat. sol.	Solid Phase	Gms. per 100	gms. sat. sol.	Solid Phase
$(\text{NH}_4)_2\text{SO}_4$	$\text{Fe}_2(\text{SO}_4)_3$		$(\text{NH}_4)_2\text{SO}_4$	$\text{Fe}_2(\text{SO}_4)_3$	
1.4	44.5	?	11.7	20.6	1.1.24
1.5	44.2	?	14.8	18.0	"
1.7	44.4	1.1.24 + ?	17.3	16.3	" + $(\text{NH}_4)_2\text{SO}_4$
1.9	43.1	1.1.24	26.6	9.0	$(\text{NH}_4)_2\text{SO}_4$
2.2	39.2	"	40.8	1.4	"
3.3	32.8	"	44.2	0.5	"
4.8	28.7	"			

1.1.24 = $\text{Fe}_2(\text{SO}_4)_3 \cdot (\text{NH}_4)_2\text{SO}_4 \cdot 24\text{H}_2\text{O}$

The Solutions contained a variable small excess of SO_4 .

FERROUS SULFATE

SOLUBILITY OF FERROUS SULFATE IN AQUEOUS SOLUTIONS
SODIUM SULFATE AT 97° AND VICE VERSA.

(Benrath and Benrath, 1929.)					
Gms. per 100	gms. sat. sol.	Solid Phase	Gms. per 100	gms. sat. sol.	Solid Phase
Na_2SO_4	FeSO_4		Na_2SO_4	FeSO_4	
0.0	19.57	$\text{FeSO}_4 \cdot \text{H}_2\text{O}$	23.30	6.68	1.1.2
1.92	18.47	"	24.91	6.51	" + 1.3
5.69	16.12	"	25.99	4.93	1.3
14.15	11.50	"	27.17	3.94	"
16.60	10.48	"	28.81	2.32	"
19.22	11.20	" + 1.1.2	28.11	2.35	" + Na_2SO_4
19.72	10.33	1.1.2	29.09	1.46	Na_2SO_4
22.87	7.32	"	30.50	0.0	"

1.1.2 = $\text{FeSO}_4 \cdot \text{Na}_2\text{SO}_4 \cdot 2\text{H}_2\text{O}$; 1.3 = $\text{FeSO}_4 \cdot 3\text{Na}_2\text{SO}_4$

**SOLUBILITY OF MIXTURES OF FERROUS SULPHATE $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$ AND
SODIUM SULPHATE $\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}$ IN WATER.**

(Koppel—Z. physik. Chem. 52, 405, '05.)

t°.	Gms. per 100 Gms. Solution.		Gms. per 100 Gms. H_2O .		Solid Phase.
	FeSO_4 .	Na_2SO_4 .	FeSO_4 .	Na_2SO_4 .	
0	14.54	4.93	18.06	6.11	$\text{FeSO}_4 \cdot 7\text{H}_2\text{O} + \text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}$
15.5	17.76	11.32	25.05	15.97	" "
21.8	16.57	15.32	24.34	22.51	$\text{FeNa}_2(\text{SO}_4)_2 \cdot 4\text{H}_2\text{O}$
24.92	16.21	15.13	23.62	22.04	"
35	16.35	14.98	23.91	21.83	"
40	16.37	15.42	24.01	22.62	"
18.8	18.13	13.8	26.63	20.28	$\text{FeNa}_2(\text{SO}_4)_2 \cdot 4\text{H}_2\text{O} + \text{FeSO}_4 \cdot 7\text{H}_2\text{O}$
23	19.58	12.5	28.82	18.4	" "
27	20.97	11.3	30.95	16.64	" "
31	22.91	9.71	33.99	14.41	" "
35	23.85	9.26	35.66	13.85	" "
40	26.32	7.85	39.98	11.92	" "
18.8	18.23	14.83	27.23	22.16	$\text{FeNa}_2(\text{SO}_4)_2 \cdot 4\text{H}_2\text{O} + \text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}$
23	13.83	18.04	20.31	26.48	" "
28	7.66	24.41	11.28	35.94	" "
31	4.58	29.50	6.95	44.75	" "
35	4.04	30.49	6.16	46.58	$\text{FeNa}_2\text{SO}_4 \cdot 4\text{H}_2\text{O} + \text{Na}_2\text{SO}_4$
40	4.10	30.60	6.27	46.99	" "

GALLIUM HYDROXIDE $\text{Ga}(\text{OH})_3$.

OH

SOLUBILITY OF GALLIUM HYDROXIDE IN AQUEOUS SOLUTIONS
OF SODIUM HYDROXIDE AT 18-20°. (Fricke and Blencke, 1925.)

Normality of aq. NaOH.	Gms. Ga_2O_3 per 100 cc. sat. sol.	Normality of aq. NaOH.	Gms. Ga_2O_3 per 100 cc. sat. sol.
1.39	0.77	11.01	7.12
3.65	2.01	11.49	5.98
7.57	4.24	12.68	4.28
9.61	7.01	12.75	4.65
10.34	9.02	15.24	2.94
10.37	8.83	15.37	2.26

GALLIUM SELENATE $\text{Ga}_2(\text{SeO}_4)_3 \cdot 22\text{H}_2\text{O}$.

An excess of air dried gallium selenate was added to water and the mixture kept at 25° for 6 hours. Constant shaking is not mentioned. Samples of the clear supernatant solution were weighed and their content of gallium determined by the sodium sulfite method.

100 gms. of the saturated solution contained 12.05 gms. Ga_2O_3 at 25°.

(Dennis and Bridgman, 1918.)

GALLIUM Ammonium SULFATE $(\text{Alum}) \text{GaNH}_4(\text{SO}_4)_2 \cdot 12\text{H}_2\text{O}$.

SO

100 cc. sat. solution in water contain 36.84 gms. $\text{NH}_4\text{Ga}(\text{SO}_4)_2 \cdot 12\text{H}_2\text{O}$ at 25°.
 " " " " 50% alcohol " 0.0217 " " "
 " " " " 70% " " 0.00875 " " "
 " " " " a mixt. of 35 cc. of H_2O + 50 cc. of $\text{C}_2\text{H}_5\text{OH}$ + 15 cc. conc. H_2SO_4
 contain 0.1613 gms. $\text{NH}_4\text{Ga}(\text{SO}_4)_2 \cdot 12\text{H}_2\text{O}$ at 25°. (Dennis and Bridgman, 1918.)

GADOLINIUM BROMATE $\text{Gd}(\text{BrO}_3)_3 \cdot 9\text{H}_2\text{O}$ **SOLUBILITY OF GADOLINIUM BROMATE IN WATER.**

(James, Fogg, McIntire, Evans and Donovan, 1927.)

	t°	Gms. $\text{Gd}(\text{BrO}_3)_3 \cdot 9\text{H}_2\text{O}$ per 100 gms. H_2O	Solid Phase	t°	Gms. $\text{Gd}(\text{BrO}_3)_3 \cdot 9\text{H}_2\text{O}$ per 100 gms. H_2O	Solid Phase
BrO	0	50.18	$\text{Gd}(\text{BrO}_3)_3 \cdot 9\text{H}_2\text{O}$	25	110.5	$\text{Gd}(\text{BrO}_3)_3 \cdot 9\text{H}_2\text{O}$
	5	60.01	"	30	126.1	"
	10	70.11	"	35	144.5	"
	15	82.64	"	40	166.0	"
	20	95.58	"	45	195.6	"

GADOLINIUM ACETATE $\text{Gd}(\text{CH}_3\text{COO})_3 \cdot 4\text{H}_2\text{O}$.

100 gms. sat. sol. of gadolinium acetate in water contain 10.37 gm. $\text{Gd}(\text{CH}_3\text{COO})_3$ at 25°.

(Meyer and Muller, 1920.)

GADOLINIUM LACTATE $\text{Gd}(\text{C}_3\text{H}_5\text{O}_3)_3 \cdot 1\frac{1}{2}\text{H}_2\text{O}$.

100 gms. sat. sol. of gadolinium lactate in water contain 0.154 gms. Gd_2O_3 , equivalent to 3.833 gms. $\text{Gd}(\text{C}_3\text{H}_5\text{O}_3)_3 \cdot 1\frac{1}{2}\text{H}_2\text{O}$, at 20°.

(Jantsch, 1926.)

GADOLINIUM GLYCOLATE $\text{Gd}_2(\text{C}_2\text{H}_3\text{O}_3)_3 \cdot 2\text{H}_2\text{O}$.

1000 cc. H_2O dissolve 14.147 gms. of the salt at 20°. (Jantsch and Grünkraut, 1912-13.)

CH

GADOLINIUM SULFONATES.**SOLUBILITY IN WATER.**

Salt.	Formula.	t°.	Gms. Anhydrous Salt per 100 Gms. H_2O .	Authority.
Gadolinium <i>m</i> Nitro- benzene Sulfonate	$\left\{ \text{Gd}[\text{C}_6\text{H}_4(\text{NO}_2)\text{SO}_3]_3 \cdot 7\text{H}_2\text{O} \right.$	15	43.8	$\left\{ \begin{array}{l} \text{(Holmberg,} \\ \text{1907.)} \\ \text{(Katz and} \\ \text{James, 1913.)} \end{array} \right.$
Gadolinium Bromoni- trobenzene Sulfonate		25	6.31	

GADOLINIUM CobaltiCYANIDE $\text{Gd}_2(\text{CoC}_6\text{N}_6)_2 \cdot 9\text{H}_2\text{O}$.

1000 gms. aq. 10% hydrochloric acid dissolve 1.86 gms. of the salt at 25°.

(James and Willard, 1916.)

GADOLINIUM OXALATE $\text{Gd}_2(\text{C}_2\text{O}_4)_3 \cdot 10\text{H}_2\text{O}$

COO

SOLUBILITY OF GADOLINIUM OXALATE IN AQUEOUS 20% SOLUTIONS OF METHYLAMINE OXALATE, ETHYLAMINE OXALATE AND TRIETHYLAMINE OXALATE.

(Grant and James, 1917.)

Solvent.	Gms. $\text{Gd}_2(\text{C}_2\text{O}_4)_3$ per 100 cc. Solvent.
Aq. 20% Methylamine Oxalate	0.069
" Ethylamine "	0.360
" Triethylamine "	0.883

SOLUBILITY OF GADOLINIUM OXALATE IN AQUEOUS SOLUTIONS OF ACIDS AT 25°. (Sarver and Brinton, 1927.)

The determinations were made gravimetrically by evaporating large volumes of the saturated solution.

Solvent concentration in normality	Gms. $Gd_2(C_2O_4)_3$ per 100 gms. sat. sol.	Solvent concentration in normality	Gms. $Gd_2(C_2O_4)_3$ per 100 gms. sat. sol.
0.1008 HCl	0.0024	0.248 HNO_3	0.0019
0.2576 "	0.0099	1.992 "	0.2785
0.5004 "	0.0329	4.054 "	0.9032
1.018 "	0.0938	2.0 " + 0.1 $(COOH)_2$	0.0768
1.484 "	0.1563	3.03 " + " "	0.2813
2.000 "	0.2457	4.00 " + " "	0.5498
0.978 " + 0.1 $(COOH)_2$	0.0061	2.0 " + 0.5 $(COOH)_2$	0.0128
2.000 " + " "	0.0525	3.03 " + " "	0.0463
2.865 " + " "	0.1448	4.0 " + " "	0.1397
3.965 " + " "	0.3777	4.0 " + sat. "	0.0383
0.978 " + 0.5 " "	0.0011	6.0 " + " "	0.1227
2.000 " + " "	0.0037	0.086 H_2SO_4	0.0086
2.865 " + " "	0.0215	0.419 "	0.0401
3.965 " + " "	0.0676	0.958 "	0.0988
1.484 " + sat. "	0.0026	1.846 "	0.2047
4.0 " + " "	0.0475	2.612 "	0.2970
6.0 " + " "	0.1921		

COO

GADOLINIUM OXALATE $Gd_2(C_2O_4)_3 \cdot 10H_2O$.

SOLUBILITY IN AQUEOUS SOLUTIONS OF SULFURIC ACID AT 25°. (Wirth, 1912.)

Normality of Aq. H_2SO_4 .	Gms. per 100 Gms. Sat. Sol.		Solid Phase.
	Gd_2O_3 .	$Gd_2(C_2O_4)_3$.	
2.16	0.1883	0.3005	$Gd_2(C_2O_4)_3 \cdot 10H_2O$
3.11	0.3010	0.4803	"
4.32	0.4359	0.6956	"
6.175	0.707	1.128	"

NO

GADOLINIUM Magnesium **NITRATE**, etc.

SOLUBILITY OF DOUBLE NITRATES OF GADOLINIUM AND OTHER METALS IN CONC.

NITRIC ACID OF $d_4 = 1.325$ (=51.59 GM. HNO_3 PER 100 CC.) AT 16°. (Jantsch, 1912.)

Salt.	Formula.	Gms. Hydrated Salt per Liter Sat. Solution.
Gadolinium Magnesium Nitrate	$[Gd(NO_3)_6]_2Mg_{3.24}H_2O$	352.3
" Nickel	" Ni_3 "	400.8
" Cobalt	" Co_3 "	451.4
" Zinc	" Zn_3 "	472.7

GADOLINIUM Dimethyl **PHOSPHATE** $Gd_2[(CH_3)_2PO_4]_3$.

100 gms. H_2O dissolve 23 gms. $Gd_2[(CH_3)_2PO_4]_3$ at 25° and 6.7 gms. at 95°.

(Morgan and James, 1914.)

SOLUBILITY OF GADOLINIUM DIMETHYL PHOSPHATE IN WATER.

(Marsh, 1939.)

t°	Gms. $Gd_2[(CH_3)_2PO_4]_3$ per 100 gms. H_2O	Gms. Gd_2O_3 per liter sat. sol.
0	37.0	126
25	24.2	82.3
50	15.7	53.4

The saturated solution at 0° was prepared by mechanical stirring for 3-4 hours. For the other temperatures the cold saturated solution was diluted somewhat and stirred occasionally for 3-4 hours.

PO

GADOLINIUM SULFATE $\text{Gd}_2(\text{SO}_4)_3 \cdot 8\text{H}_2\text{O}$.

SOLUBILITY IN WATER. (Benedicks, 1900.)

t°.	Gms. $\text{Gd}_2(\text{SO}_4)_3$ per 100 Gms. H_2O .	Solid Phase.
0	3.98	$\text{Gd}_2(\text{SO}_4)_3 \cdot 8\text{H}_2\text{O}$
10	3.3	"
14	2.8	"
25	2.4	"
34.4	2.26	"

100 gms. H_2O dissolve 2.886 gms. $\text{Gd}_2(\text{SO}_4)_3 \cdot 8\text{H}_2\text{O}$ at 20° and 2.19 gms. at 40°. (Jackson and Rienacker, 1930.)

SOLUBILITY OF GADOLINIUM SULFATE IN AQUEOUS SOLUTIONS OF:

Sodium Sulfate at 25°. (Bissell and James, 1916.)

Sulfuric Acid at 25°. (Wirth, 1912.,

Gms. per 100 Gms. H_2O .		Solid Phase.	Normality of H_2SO_4 .	Gms. per 100 Gms. Sat. Sol.		Solid Phase.
Na_2SO_4 .	$\text{Gd}_2(\text{SO}_4)_3$.			Gd_2O_3	$= \text{Gd}_2(\text{SO}_4)_3$	
0	2.15	$\text{Gd}_2(\text{SO}_4)_3 \cdot 8\text{H}_2\text{O}$	0	1.793	2.981	$\text{Gd}_2(\text{SO}_4)_3 \cdot 8\text{H}_2\text{O}$
0.43	2.06	"	0.1	1.98	3.291	"
0.47	0.76	$\text{Gd}_2(\text{SO}_4)_3 \cdot \text{Na}_2\text{SO}_4 \cdot 2\text{H}_2\text{O}$	0.505	2.365	3.931	"
1.26	0.17	"	1.1	2.29	3.807	"
3.01	0.07	"	2.16	1.789	2.974	"
7.46	0.05	"	6.175	0.528	0.8777	"
27.40	0.05	"	12.6	0.0521	0.0867	"

GERMANIUM Tetra CHLORIDE GeCl_4

MISCIBILITY OF GERMANIUM TETRA CHLORIDE AND SULFUR DIOXIDE.

(Bond and Crone, 1934.)

The synthetic method was used and the temperatures of melting or disappearance of the second liquid layer determined.

t°	Gms. GeCl_4 per 100 gms. sat. sol.	t°	Gms. GeCl_4 per 100 gms. sat. sol.	t°	Gms. GeCl_4 per 100 gms. sat. sol.
-51.8(m.pt.)	100.	-4.9	63.98	-51.5	7.0
-75.0(-53.9)	98.80	-4.9	63.06	-55.2	6.26
-61.9(-55.0)	97.97	-4.7	59.87	-60.5(-58.0)	5.15
-53.0	97.97	-4.7	58.81	-67.1(-61.2)	4.21
-46.6	96.41	-4.9	52.37	-73.0(-64.5)	3.48
-31.0	93.72	-5.1	49.92	-76.1(-66.8)	3.07
-27.2	92.72	-5.5	45.00	-79.2(-66.8)	2.71
-24.2	91.76	-6.2	41.86	-86.0(-71.8)	2.17
-21.1	90.58	-7.4	37.78	-88.0(-72.8)	2.07
-15.0	87.42	-9.0	34.22	(-76.5)	1.55
-12.3	85.54	-10.1	31.95	(-76.5)	1.48
-9.2	82.24	-13.1	27.52	(-76.1)	0.94
-7.1	78.62	-24.6	17.52	(-75.9)	0.72
-6.1	75.36	-32.7	13.16	(-75.5)	0.00
-5.2	69.42	-36.4	11.31		
-5.2	68.78	-41.2	10.07		
-5.0	67.59				

The figures in parentheses are melting points.

SOLUBILITY OF GERMANIUM DOUBLE FLUORIDES IN WATER, EACH
DETERMINED SEPARATELY.

(Müller, 1927.)

Germanium Double Fluoride of:	Formula of Salt	Gms. Salt per 100 cc sat. solution at:						
		0°	10°	25°	30°	40°	60°	
Lithium	GeLi ₂ F ₆	—	—	53.92	—	—	—	
Sodium	GeNa ₂ F ₆	1.52	1.68	—	2.25	2.83	3.36	F
Potassium	GeK ₂ F ₆	0.25	0.363	0.59	0.65	0.95	—	
Rubidium	GeRb ₂ F ₆	0.23	0.302	—	0.74	—	—	
Caesium	GeCs ₂ F ₆	0.84	0.98	1.89	2.28	—	—	
Tellurium	GeTe ₂ F ₆	14.13	—	—	34.58	—	—	
Silver	GeAg ₂ F ₆	—	—	—	88.03	—	—	

GERMANIUM DIOXIDE GeO₂.

100 gms. H₂O dissolve 0.405 gm. GeO₂ at 20°, and 1.07 gms. at 100°. (Winkler, 1887.)

SOLUBILITY OF GERMANIUM DIOXIDE IN WATER.

(Schwarz and Huf, 1931.)

The Germanium dioxide was prepared by distilling germanite 4-5 times in a stream of chlorine, freeing the tetrachloride thus obtained of chlorine by means of Hg and hydrolysing in distilled water. Several determinations made with such samples gave the following results at 20°.

Preliminary treatment of sample	Hours allowed for saturation	Gms. GeO ₂ per 100 cc sat. sol.	
Hydrolysis 6 hrs. with 30.6% H ₂ O	30	0.534	
" with 3.7% H ₂ O drying over KOH 14 hrs, age 58 hrs.	35	0.596	
Hydrolysis of GeO ₂ , heated 2 hrs. at 600°	28-51	0.430	
" " " " " " " 400°	143	0.349	
Boiling in H ₂ O (hydrolysed, dried)	—	0.747	
Melted GeO ₂	32	0.572	

The following results at different temperatures were obtained with a preparation which had been heated to 600° and was used in the ratio of 0.4 gm. per 100 cc H₂O.

0°	11°	20°	26°	35°	41°
Gms. GeO ₂ per 100 cc sat. sol.	0.396	0.430	0.470	0.551	0.617

A table of results is also given showing that the variations of solubility of GeO₂ in Water depends upon the preliminary treatment of the sample as well as upon the ratio of solid to water used in the determination.

The properties of the modifications of GeO₂ obtained by various means are described by Müller and Blank, 1924; and Müller, 1926.

GERMANIUM DIOXIDE

SOLUBILITY OF GERMANIUM DIOXIDE IN AQUEOUS SOLUTIONS
OF HYDROCHLORIC ACID, SULFURIC ACID AND SODIUM HYDROXIDE AT 25°.
(Fugh, 1929.)

The object of the determinations was to obtain evidence of the amphoteric character of germanium hydroxide and supply comparative values of the acid and basic dissociation constants of this compound. The GeO_2 was prepared from the pure disulfide by repeated treatment with HNO_3 and ignition to bright red heat. The oxide, which had not been allowed to fuse, was ground with water, washed until free of H_2SO_4 and finally reignited. It was found that 8-10 days agitation were necessary for attainment of equilibrium.

O	Results for aq. Hydrochloric Acid		Results for aq. Sulfuric Acid		Results for aq. Sodium Hydroxide	
	Gm. Mols. HCl per liter	Gms. GeO_2 per 100cc sat. sol.	Gm. Mols. H_2SO_4 per liter	Gms. GeO_2 per 100cc sat. sol.	Gm. Mols. per NaOH	liter sat. sol. GeO_2
	0.0	0.4470	0.0	0.4470	0.0	0.0428
	0.25	0.4115	0.50	0.3550	0.00125	0.0440
	0.50	0.3810	0.98	0.2805	0.0025	0.0483
	1.50	0.2600	1.50	0.2000	0.005	0.0545
	2.0	0.2185	2.05	0.1600	0.010	0.0675
	2.925	0.1544	2.52	0.1305	0.0125	0.0746
	3.85	0.1140	3.02	0.099	0.025	0.1115
	4.35	0.0920	3.50	0.074	0.050	0.1693
	5.20	0.074	4.0	0.050	0.100	0.2280
	5.72	0.102	4.5	0.041		
	6.23	0.1820	5.85	0.019		
	6.85	0.3164	7.95	0.009		
	7.62	0.7660	(95%)	0.140		

Fusion-point data for mixtures of $\text{GeO}_2 + \text{K}_2\text{O}$ and $\text{GeO}_2 + \text{Na}_2\text{O}$ are given by Schwarz and Heinrich, 1932.

GERMANIUM (Mono) SULFIDE GeS **S GERMANIUM (Di) SULFIDE GeS_2**

100 gms. H_2O dissolve 0.24 gm. GeS

100 gms. H_2O dissolve 0.45 gm. GeS_2 .

(Winkler, 1887.)

100 gms. liquid NH_3 dissolve 0.0473 gm. GeS (= 0.0031 Gm. Mol. GeS per liter) at -33° .

100 gms. liquid NH_3 dissolve 3.112 gm. GeS_2 (= 0.1551 Gm. Mol. GeS_2 per liter) at -32.9° .
(Johnson and Wheatley, 1934.)

HYDROGEN H₂.

SOLUBILITY OF HYDROGEN IN WATER.

(Milligan, 1924.)

Hydrogen mixed with air was shaken for 2 minutes with distilled water previously saturated with air. The gas phase was analyzed by means of a Haldane gas analysis apparatus before and after contact with the water and the amount of hydrogen dissolved was estimated by difference. It was found that 1 cc. of H₂ O at 25° dissolves 0.017 cc. hydrogen (reduced to 0°) when the pressure of the gas over the water is 760 mm.

SOLUBILITY OF HYDROGEN IN WATER.

(Winkler — Ber. 24, 99, '91; Bohr and Bock — Wied. Ann. 44, 318, '91; Timofejew — Z. physik. Chem. 6, 147, '90.)

t°.	β.	l.		β.	g.
0	0.0214	...	...	0.0214	0.000193
5	0.0203	0.0209	— 0.0241	0.0204	0.000184
10	0.0193	0.0204	— 0.0229	0.0195	0.000176
15	0.0185	0.0200	— 0.0217	0.0188	0.000169
20	0.0178	0.0196	— 0.0205	0.0182	0.000162
25	0.0171	0.0193	— 0.0191	0.0175	0.000156
30	0.0163	...	...	0.0170	0.000147
40	0.0153	...	...	0.0164	0.000139
50	0.0141	...	...	0.0161	0.000129
60	0.0129	...	...	0.0160	0.000119
80	0.0085	...	...	0.0160	0.000079
100	0.0000	...	...	0.0160	0.000000

H

β = Bunsen Absorption Coefficient which is the volume of gas (reduced to 0° and 760 mm) absorbed by 1 volume of the liquid when the pressure of the gas itself without the tension of the liquid amounts to 760 mm.

β' = Solubility, or the volume of gas (reduced to 0° and 760 mm) which is absorbed by 1 volume of the liquid at barometric pressure of 760 mm.

g = the weight of gas in grams dissolved by 100 gms. of pure solvent, at the indicated temperature and a total pressure (that is, the partial pressure of the gas plus the vapor pressure of the liquid at the absorption temperature) of 760 mm.

l = the Ostwald Solubility Expression which represents the ratio of the volume (v) of gas absorbed at any pressure and temperature, to the volume (V) of the absorbing liquid, thus $l = \frac{v}{V}$. This expression differs from the Bunsen Absorption coefficient β in that the volume (v) of the dissolved gas is not reduced to 0° & 760 mm. The solubility l is therefore the volume of gas dissolved by unit volume of the solvent at the temperature of the experiment. The two expressions are related thus:

$$l = \beta(1 + 0.00367t), \quad \beta = \frac{l}{(1 + 0.00367t)}$$

HYDROGEN H_2 SOLUBILITY OF HYDROGEN IN WATER AT VARIOUS TEMPERATURES AND AT
25 TO 1000 ATMOSPHERES PRESSURE.

(Wiebe and Gaddy, 1934.)

The authors used the same method previously employed at 25°. The hydrogen contained 0.1 percent N for which a correction proportional to its mol fraction was applied. A correction for change of vapor pressure due to the gas pressure on the liquid, was made. By a sensitive method of plotting deviations the experimental data were smoothed with respect to both pressure and temperature to obtain the following interpolated solubility values.

Pressure in Atmospheres	cc H_2 (reduced to 0° and 760mm) dissolved by 1.0 gm. H_2O at:					
	0°	10°	20°	30°	40°	50°
25	0.5363	0.4870	0.4498	0.4263	0.4133	0.4067
50	1.068	0.9690	0.8945	0.8475	0.8215	0.8090
75	1.601	1.453	1.341	1.271	1.232	1.212
100	2.130	1.932	1.785	1.689	1.638	1.612
150	3.168	2.872	2.649	2.508	2.432	2.395
200	4.187	3.796	3.499	3.311	3.210	3.165
300	6.139	5.579	5.158	4.897	4.747	4.695
400	8.009	7.300	6.766	6.430	6.245	6.166
500	9.838	8.980	8.328	7.922	7.705	7.613
600	11.626	10.610	9.856	9.390	9.135	9.017
700	13.370	12.214	11.362	10.818	10.524	10.389
800	15.013	13.746	12.808	12.218	11.889	11.735
900	16.548	15.215	14.217	13.583	13.230	13.072
1000	18.001	16.623	15.592	14.928	14.569	14.404

Pressure in Atmospheres	cc H_2 (reduced to 0° and 760mm) dissolved by 1.0 gm. H_2O at:				
	60°	70°	80°	90°	100°
25	0.4053	0.4093	0.4203	0.4385	0.4615
50	0.8095	0.8171	0.8385	0.8720	0.9120
75	1.211	1.224	1.254	1.298	1.355
100	1.610	1.628	1.667	1.727	1.805
150	2.393	2.422	2.485	2.576	2.681
200	3.168	3.208	3.286	3.402	3.544
300	4.692	4.746	4.866	5.042	5.220
400	6.173	6.249	6.392	6.600	6.841
500	7.625	7.717	7.885	8.129	8.429
600	9.016	9.131	9.324	9.665	9.994
700	10.405	10.527	10.757	11.093	11.512
800	11.746	11.893	12.169	12.555	12.980
900	13.084	13.233	13.533	13.946	14.394
1000	14.407	14.557	14.867	15.303	15.775

The authors extrapolated the results at 25 atmospheres to lower pressures by means of Henry's law to obtain values at one atmosphere. These results when converted to terms of the Bunsen and Ostwald coefficients agree fairly well with the data of Winkler except at the higher temperatures.

HYDROGEN H₂SOLUBILITY OF HYDROGEN IN WATER AT 25° AND AT 25 TO 1000
ATMOSPHERES PRESSURE.

(Wiebe, Gaddy and Helms, Jr., 1932.)

The authors used a simple bubbling-type of apparatus made of a steel cylinder with pressure valves. Equilibrium was approached from both lower and higher pressures. The experimental accuracy was about 0.5 percent except at the lower pressures.

Atmospheres Pressure	cc. H ₂ (reduced to 0° and 760mm) dissolved by 1.0 gm. H ₂ O	Atmospheres Pressure	cc H ₂ (reduced to 0° and 760mm) dissolved by 1.0 gm. H ₂ O
25	0.436 ± 0.008	400	6.57 ± 0.04
50	0.867 ± 0.012	600	9.58 ± 0.05
100	1.728 ± 0.017	800	12.46 ± 0.06
200	3.39 ± 0.03	1000	15.20 ± 0.08

Additional data for the solubility of H₂ in water at pressures up to 10 atmospheres are given by Cassuto, 1913.

H

SOLUBILITY OF HYDROGEN IN WATER AT 25° AND AT PRESSURES
UP TO 150 ATMOSPHERES.

(Frolich, Touch, Hogan and Peer, 1931.)

The determinations were made by shaking water and hydrogen at various pressures in a steel cylinder maintained at 25°, and, after attainment of equilibrium, withdrawing a sample of the mixture over mercury in one of three burets so designed that the volumes could be measured with the same degree of accuracy at any ratio of gas to liquid. The results are given in the form of a diagram from which the following approximate values were read.

Pressure in atmospheres	cc. H ₂ (measured at 25° and 1 Atm. pressure) dissolved by 1.0 cc H ₂ O
50	2.0
80	3.0
120	4.5
150	5.5

SOLUBILITY OF HYDROGEN IN WATER AT HIGH PRESSURES.
(Ipatiew, Jr., Drushina, -Artemowitsch and Tichomirov, 1931, 1932.)

Mixtures of water and hydrogen under pressure were rotated in a steel cylinder at constant temperatures. Equilibrium was reached in comparatively short periods of time. Samples of the mixture were removed to a buret containing mercury and the volumes of liquid and gas accurately measured at room temperature and the gas volume reduced to 0° and 760mm.

t°	H ₂ Pressure in Atmospheres	CC. H ₂ (reduced to 0° & 760 mm) dissolved in 100 cc H ₂ O	t°	CC. H ₂ (reduced to 0° and 760mm) dissolved in 100 cc H ₂ O at 100 Atmospheres Pressure
25	20	33.0	0.5	196.3
"	40	66.4	5.0	188.0
"	60	100.2	10.0	180.0
"	80	132.8	15.0	174.3
"	100	165.3	20.0	168.3
"	120	199.2	25.0	165.5
"	140	231.0	35.0	162.5
			45.0	158.7
			100.0	158.0

In a subsequent paper by Ipatiew, Jr., and Theodorawtch, 1934, results for the Solubility of Hydrogen in Water at temperatures up to 225° and at pressures varying between 30 and 100 atmospheres, are given.

SOLUBILITY OF A MIXTURE OF 76.42 PERCENT HYDROGEN AND 25.58 PERCENT NITROGEN IN WATER AT 25° AND AT 50 TO 1000 ATMOSPHERES PRESSURE.
(Wiebe and Gaddy, 1935.)

The approximately 3.1 mixture of hydrogen and nitrogen was prepared by burning hydrogen in air. The amount of argon introduces an uncertainty of about 0.2 percent. The same bubbling method was used as previously employed by the authors for determinations of the solubility of hydrogen in water at different temperatures and pressures. The composition of the gas in the two phases was analyzed by means of a modified form of thermal conductivity apparatus containing glass instead of the usual metal cells.

Pressure in atmospheres	cc H ₂ (reduced to 0° and 760mm) dissolved in 1.0 gm. H ₂ O	Av. percent H ₂ in the gas present in the liquid phase	Av. percent H ₂ in the gas present in the gas phase
50	0.8349	80.17	76.42
100	1.643	80.89	76.42
200	3.209	82.68	76.42
400	6.068	84.33	76.42
600	8.809	84.92	76.42
800	11.327	85.32	76.42
1000	13.724	85.81	76.42

Thermodynamical calculations of the solubility of Hydrogen and Nitrogen and their mixtures in Water at pressures up to 1000 atmospheres based upon the above results are given by Krichevsky and Kasarnovsky, 1935, 1936, and by Kielland, 1936.

SOLUBILITY OF HYDROGEN IN AQUEOUS SOLUTIONS OF ACIDS AND BASES AT 25°.

(Geffcken — Z. physik. Chem. 49, 268, '04.)

Gram Equiv. Acids and Bases per Liter.	Solubility of H (l_{25} = Ostwald Expression) in Solutions of:						
	HCl.	HNO ₃ .	$\frac{1}{2}$ H ₂ SO ₄ .	CH ₃ COOH.	CH ₃ ClCOOH.	KOH.	NaOH.
0.0	0.0193	0.0193	0.0193	0.0193	0.0193	0.0193	0.0193
0.5	0.0186	0.0188	0.0185	0.0192	0.0189	0.0167	0.0165
1.0	0.0179	0.0183	0.0177	0.0191	0.0186	0.0142	0.0139
2.0	0.0168	0.0174	0.0163	0.0188	0.0180	...	0.0097
3.0	0.0159	0.0167	0.0150	0.0186	...	...	0.0072
4.0	...	0.0160	0.0141	0.0186	...	...	0.0055

The above figures for the concentrations of acids and bases were calculated to grams per liter, and these values with the corresponding l_{25} values for the solubility of hydrogen, plotted on cross-section paper. From the resulting curves, the following table was read:

Grams Acids and Bases per Liter.	Solubility of H (l_{25} = Ostwald Expression) in Solutions of:						
	HCl.	HNO ₃ .	$\frac{1}{2}$ H ₂ SO ₄ .	CH ₃ COOH.	CH ₃ ClCOOH.	KOH.	NaOH.
0	0.0193	0.0193	0.0193	0.0193	0.0193	0.0193	0.0193
20	0.0185	0.0189	0.0186	0.0192	0.0191	0.0172	0.0165
40	0.0179	0.0186	0.0180	0.0191	0.0190	0.0153	0.0140
60	0.0173	0.0183	0.0174	0.0190	0.0188	0.0135	0.0117
80	0.0167	0.0180	0.0168	0.0189	0.0187	...	0.0097
100	0.0160	0.0179	0.0162	0.0189	0.0185	...	0.0082
150	...	0.0171	0.0148	0.0188	0.0182	...	0.0058
200	...	0.0165	0.0140	0.0186	0.0179	...	...
250	...	0.0160	...	0.0184	...	...	...

THE SOLUBILITY OF HYDROGEN IN CONC. H₂SO₄ AT 20°.

(Christoff, 1906.)

% H ₂ SO ₄	0	35.82	61.62	95.6
l_{20}	0.0208	0.00954	0.00708	0.01097

SOLUBILITY OF HYDROGEN IN AQUEOUS PROPIONIC ACID SOLUTIONS.

(Braun, 1900.)

Gms. C ₂ H ₃ COOH per 100 Gms. Solution.	Coefficient of Absorption of Hydrogen at:				
	5°.	10°.	15°.	20°.	25°.
2.63	0.02245	0.0214	0.0200	0.0188	0.0172
3.37	0.0222	0.0212	0.0199	0.0187	0.0171
5.27	0.0224	0.0212	0.0198	0.0184	0.0171
6.50	0.0218	0.0209	0.0193	0.0183	0.0169
9.91	0.0213	0.0203	0.0191	0.0178	0.0160

SOLUBILITY OF HYDROGEN IN AQUEOUS SODIUM HYDROXIDE AND OTHER SOLVENTS AT 100 ATMOSPHERES PRESSURE.

(Ipatiew, Jr., Drushina-Artemowitsch and Tichonirrow, 1931-1932.)

t°	Solvent	cc H ₂ (reduced to 0° and 760mm) per 100 cc solvent
25	Aq. 20% NaOH Solution	41.7
25	Methyl alcohol	869.5
25	Benzene	694.4

H HYDROGEN

SOLUBILITY OF HYDROGEN IN AQUEOUS SOLUTIONS OF AMMONIUM NITRATE AT 20°.

(Knopp — Z. physik. Chem. 48, 103, '04.)

ρ .	Normality (per 1000 Gms.) H ₂ O.	Molecular Concentra- tion.	Absorption Coefficient of Hydrogen.	Density of Solutions.
0.00	0.00	0.00	0.0188	...
1.037	0.1308	0.002352	0.01872	1.0027
2.167	0.2765	0.004956	0.01845	1.0072
3.378	0.4363	0.007799	0.01823	1.0122
4.823	0.6333	0.011280	0.01773	1.0182
6.773	0.9069	0.016447	0.01744	1.0262
11.550	1.6308	0.028525	0.01647	1.04652

SOLUBILITY OF HYDROGEN IN AQUEOUS SOLUTIONS OF BARIUM CHLORIDE.

(Braun — Z. physik. Chem. 33, 735, '00.)

Gms. BaCl ₂ per 100 Gms. Solution.	Coefficient of Absorption of Hydrogen at :				
	5°.	10°.	15°.	20°.	25°.
0.00	0.0237	0.0221	0.0206	0.0191	0.0175
3.29	0.0211	0.0198	0.0185	0.0172	0.0157
3.6	0.0209	0.0197	0.0184	0.0170	0.0156
6.45	0.0196	0.0186	0.0173	0.0161	0.0147
7.00	0.0194	0.0183	0.0172	0.0159	0.0146

H

SOLUBILITY OF HYDROGEN IN AQUEOUS SOLUTIONS OF CALCIUM CHLORIDE, MAGNESIUM SULPHATE, AND LITHIUM CHLORIDE AT 15°.

(Gordon — Z. physik. Chem. 18, 14, '95.)

Coefficient of Absorption of hydrogen in water at 15° = 0.01883.

In Calcium Chloride.			In Magnesium Sulphate.			In Lithium Chloride.		
Gms. CaCl ₂ per 100 g. Sol.	G. M. CaCl ₂ per Liter.	Absorption Coefficient of H.	Gms. MgSO ₄ per 100 g. Sol.	G. M. MgSO ₄ per Liter.	Absorption Coefficient of H.	Gms. LiCl per 100 g. Sol.	G. M. LiCl per Liter.	Absorption Coefficient of H.
3.47	0.321	0.01619	4.97	0.433	0.01501	3.48	0.835	0.01619
6.10	0.578	0.01450	10.19	0.936	0.01159	7.34	1.800	0.01370
11.33	1.122	0.01138	23.76	2.501	0.00499	14.63	3.734	0.0099
17.52	1.1827	0.00839						
26.34	2.962	0.00519						

For definition of Coefficient of Absorption, see page 553

SOLUBILITY OF HYDROGEN IN AQUEOUS SOLUTIONS OF POTASSIUM CARBONATE, CHLORIDE, AND NITRATE AT 15°.

(Gordon.)

In Potassium Carbonate.			In Potassium Chloride.			In Potassium Nitrate.		
Gms. K ₂ CO ₃ per 100 g. Sol.	G. M. K ₂ CO ₃ per Liter.	Absorption Coefficient of H.	Gms. KCl per 100 g. Sol.	G. M. KCl per Liter.	Absorption Coefficient of H.	Gms. KNO ₃ per 100 g. Sol.	G. M. KNO ₃ per Liter.	Absorption Coefficient of H.
2.82	0.209	0.01628	3.83	0.526	0.01667	4.73	0.482	0.01683
8.83	0.690	0.01183	7.48	1.051	0.01489	8.44	0.879	0.01559
16.47	1.376	0.00761	12.13	1.755	0.01279	16.59	1.820	0.01311
24.13	2.156	0.00462	19.21	2.909	0.01012	21.46	2.430	0.01180
41.81	4.352	0.00160	22.92	3.554	0.00897			

SOLUBILITY OF HYDROGEN IN AQUEOUS SOLUTIONS OF POTASSIUM
CHLORIDE AND NITRATE AT 20°.

(Knopp — Z. physik. Chem. 48, 103, '04.)

In Potassium Chloride.				In Potassium Nitrate.			
p.	Normality (per 1000 g. H ₂ O).	Absorption Coefficient.	Density of Solutions.	p.	Normality (per 1000 g. H ₂ O).	Absorption Coefficient.	Density of Solutions.
1.089	0.1475	0.01823	1.0052	1.224	0.1245	0.01835	1.0059
2.123	0.2907	0.01757	1.0118	2.094	0.2114	0.01818	1.0113
4.070	0.5687	0.01661	1.0243	4.010	0.4127	0.01785	1.0236
6.375	0.9127	0.01531	1.0394	5.925	0.6225	0.01743	1.0359
7.380	1.0682	0.01472	1.0460	7.742	0.8293	0.01667	1.0477
13.612	2.1222	0.01255	1.0875	13.510	1.5436	0.01436	1.0865

SOLUBILITY OF HYDROGEN IN AQUEOUS SODIUM CARBONATE AND
SULPHATE SOLUTIONS AT 15°.

(Gordon.)

In Sodium Carbonate.			In Sodium Sulphate.		
Gms. Na ₂ CO ₃ per 100 Gms. Solution.	G. M. Na ₂ CO ₃ per Liter.	Absorption Coefficient of H.	Gms. Na ₂ SO ₄ per 100 Gms. Solution.	G. M. Na ₂ SO ₄ per Liter.	Absorption Coefficient of H.
2.15	0.207	0.01639	4.58	0.335	0.01519
8.64	0.438	0.01385	8.42	0.638	0.0154
11.53	1.218	0.00839	16.69	1.364	0.00775

H

SOLUBILITY OF HYDROGEN IN AQUEOUS SOLUTIONS OF SODIUM
CHLORIDE.

(Braun; Gordon.)

Gms. NaCl per 100 Gms. Solution.	Coefficient of Absorption of Hydrogen at:				
	5°.	10°.	15°.	20°.	25°.
1.25	0.0218	0.0205	0.0191	0.0177	0.0162
3.80	0.0198	0.0188	0.0176	0.0162	0.0148
4.48	0.0192	0.0182	0.0171	0.0159	0.0143
6.00	0.0184	0.0175	0.0164	0.0153	0.0138
14.78	..	...	0.0093	...	...
23.84	...	...	0.00595	...	...

SOLUBILITY OF HYDROGEN IN AQUEOUS SOLUTIONS OF SODIUM
NITRATE.

In Sodium Nitrate at 20°.
(Knopp.)

In Sodium Nitrate at 15°.
(Gordon.)

p.	Normality (per 1000 Gms. H ₂ O).	Absorption Coefficient of H.	Density of Solutions.	Gms. NaNO ₃ per 100 Gms. Solution.	G. M. NaNO ₃ per Liter.	Absorption Coefficient of H.
1.041	0.1236	0.01839	1.0052	5.57	0.679	0.01603
2.192	0.2634	0.01774	1.0130	11.16	1.413	0.0137
4.405	0.5416	0.01694	1.0282	19.77	2.656	0.01052
6.702	0.8442	0.01518	1.04411	37.43	5.711	0.00578
12.637	1.7354	0.0130	1.08667			

II HYDROGEN

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SOLUBILITY OF HYDROGEN IN AQUEOUS SOLUTIONS OF VARIOUS SALTS AT 15°.

(Steiner, 1894.)

Salt in Aq. Solution.	Bunsen Absorption Coefficient β ($\times 10^4$) in Aq. Solution of Normality.								
	0.	1.	2.	3.	4.	5.	6.	7.	9.
LiCl	1883	1574	1325	1121	949	...	...	...	...
KNO ₃	1883	1524	1276	1076	...	...	...	...	...
$\frac{1}{2}$ AlCl ₃	1883	1511	1221	993	810	667	550	...	...
KCl	1883	1502	1217	996	820	...	...	...	...
NaNO ₃	1883	1496	1201	984	808	667	542	...	...
$\frac{1}{2}$ CaCl ₂	1883	1493	1195	958	780	635	510	...	...
NaCl	1883	1478	1144	380	699	573	...	...	...
$\frac{1}{2}$ MgSO ₄	1883	1451	1120	856	659	499	...	...	...
$\frac{1}{2}$ ZnSO ₄	1883	1446	1113	852	667	510	...	...	...
$\frac{1}{2}$ Na ₂ SO ₄	1883	1370	991	710	...	...	...	...	...
$\frac{1}{2}$ K ₂ CO ₃	1883	1338	967	700	508	372	273	206	158
$\frac{1}{2}$ Na ₂ CO ₃	1883	1340	699	...	...	...	...	...	...
Cane Sugar	1883	1280	731	...	...	...	...	...	...

SOLUBILITY OF HYDROGEN IN ALCOHOL. (Timofeiew, 1890; Bunsen-Heurich, 1892.)

t°.	Coef. of Absorption in 98.8% Alcohol.	t°.	Coef. of Absorption in 7% Alcohol.	t°.	Coef. of Absorption in Pure Alcohol (Bunsen).
0	0.0676	4	0.0749	1	0.06916
6.2	0.0693	18.8	0.0740	5	0.06847
13.4	0.0705			11.4	0.06765
				23.7	0.06633

SOLUBILITY IN AQUEOUS ALCOHOL SOLUTIONS AT 20° AND 760 MM. PRESSURE. (Lubarsch, 1889.)

Wt. % Alcohol.	Vol. % Absorbed H.	Wt. % Alcohol.	Vol. % Absorbed H.
0	1.93	28.57	1.04
9.09	1.43	33.33	1.17
16.67	1.29	50	2.02
23.08	1.17	66.67	2.55

SOLUBILITY OF HYDROGEN IN AQ. SOLUTIONS OF CHLORAL HYDRATE. (Müller, C. 1912-13.)

t°.	Gms. Chloral Hydrate per 100 Gms. Aq. Sol.	d ₂₀ of Aq. Solution.	Absorption Coefficient.	
			β_{15}	β_{20}
19.4	15.5	1.0722	0.01732	0.01724
17.4	28.3	1.143	0.01569	0.01540
18.7	46.56	1.2505	0.01388	0.01375
16.5	52	1.2870	0.01314	0.01280
17	63	1.371	0.01270	0.01243
17.9	68	1.4097	0.01286	0.01270
18.3	78.4	1.4993	0.01398	0.01380

SOLUBILITY OF HYDROGEN IN CHLORAL HYDRATE SOLUTIONS AT 20°. (Knopp, 1904.)

β .	Normality (per 1000 Gms. H ₂ O).	Molecular Concentration.	Absorption Coefficient of H.	Density of Solutions.
4.91	0.310	0.005594	0.01839	1.0202
7.69	0.504	0.008992	0.01802	1.0320
14.56	1.030	0.018223	0.01712	1.0669
29.50	2.530	0.043601	0.01542	1.1466
38.42	3.770	0.063647	0.01440	1.1982
49.79	6	0.097493	0.01353	1.2724
63.90	10.700	0.161660	0.01307	1.3743

For definition of Bunsen Absorption Coef., see p. 553

SOLUBILITY OF HYDROGEN IN AQUEOUS SOLUTIONS OF GLYCEROL.

Results at 14° and 21° (Henkel, 1905, 1912.)			Results at 25° (Drucker and Moles, 1910.)		
t°.	Wt. % Glycerol.	Absorp. Coef. β (Sec p. 227.)	Wt. % Glycerol.	d_{25}^{25} Sat. Sol.	l_{25} (Ostwald Expression).
14	0	0.0193	0	1	0.0196
"	2.29	0.0189	4	1.0101	0.0186
"	5.32	0.0186	10.5	1.0260	0.0178
"	8.57	0.0182	22	1.0542	0.0154
"	10.83	0.01815	49.8	1.1290	0.0099
"	15.31	0.01765	50.5	1.1300	0.0097
21	0	0.0184	52.6	1.1365	0.0090
"	2.29	0.0181	67	1.1752	0.0067
"	5.68	0.0177	80	1.2113	0.0051
"	6.46	0.0176	82	1.2159	0.0051
"	10.40	0.0171	88	1.2307	0.0044
"	18.20	0.0160	95	1.2502	0.0034

Additional data for this system are given by Müller, C. 1912-13.

SOLUBILITY OF HYDROGEN IN AQUEOUS SOLUTIONS OF SEVERAL COMPOUNDS.
(Hüfner, 1906-07.)

Aqueous Solution of:	Conc. of Solvent Gms. per Liter.	t.	Absorption Coef. β .
Water alone	0	20.11	0.0181
Dextrose (Grape Sugar)	41.45	20	0.0176
"	87.3	20.25	0.0166
"	174	20.28	0.0152
Urea	60	20.17	0.0170
Acetamide	59	20.11	0.0180
Alanine	89	20.08	0.0156
Glycocol	75	20.16	0.0158

H

SOLUBILITY OF HYDROGEN IN AQUEOUS SOLUTIONS OF CANE SUGAR AND
OF GRAPE SUGAR. (Müller, C. 1912-13.)

t°.	Wt. % Cane Sugar.	Sp. Gr. Sat. Sol.	Abs. Coef. β_{15} .	t°.	Wt. % Grape Sugar.	Sp. Gr. Sat. Sol.	Abs. Coef. β_{20} .
15.2	5.04	$d_{15} = 1.019$	0.0173	19.3	0	...	0.0184
11.6	14.7	$d_{11} = 1.060$	0.0151	20.5	12.2	$d_{20} = 1.048$	0.0160
12	20.26	$d_{11} = 1.084$	0.0146	20.5	20.7	$d_{20} = 1.084$	0.0145
12.7	29.86	$d_{13} = 1.128$	0.0126	21.1	32.56	$d_{20} = 1.130$	0.0125
11.8	31.74	$d_{12} = 1.138$	0.0119	21.8	45.8	$d_{20} = 1.199$	0.0102
13.3	39.65	$d_{13.5} = 1.175$	0.0103	21.2	59	$d_{20} = 1.266$	0.0078
12.6	42.94	$d_{12.5} = 1.195$	0.0094				

SOLUBILITY OF HYDROGEN IN AQUEOUS SUGAR SOLUTIONS AT 15°. (Gordon, 1895.)

Gms. Sugar per 100 Gms. Solution.	Gm. Mols. Sugar per Liter.	Absorption Coefficient of H.
16.67	0.520	0.01561
30.08	0.993	0.01284
47.65	1.699	0.00892

SOLUBILITY OF HYDROGEN AT 25° (Findlay and Shen, 1912) IN AQ. SOLUTIONS OF:

Dextrin.			Starch.			Gelatin.		
Gms. Dextrin per 100 cc.	Sp. Gr.	l_{25} .	Gms. Starch per 100 cc.	Sp. Gr.	l_{25} .	Gms. Gelatin per 100 cc	l_{25} .	
3.98	1.012	0.0194	2.01	1.005	0.0194	1.53	0.0194	
8.58	1.019	0.0191	3.56	1.011	0.0189	2.60	0.0189	
8.12	1.028	0.0188	7.13	1.024	0.0181	4.74	0.0185	
19.20	1.066	0.0174	9.29	1.032	0.0182	5.71	0.0182	

HYDROGEN

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COMPARATIVE SOLUBILITY OF HYDROGEN AT 38° AND ATMOSPHERIC PRESSURE IN WATER AND IN OX BLOOD SERUM AND CELLS.

(Van Slyke and Sendroy Jr., 1928.)

Solvent	Abs. Coef. cc H ₂ per 1 cc sat. sol.
Water	0.01630
Aq. 0.15 normal NaCl	0.01559
Ox Blood Serum	0.01533
Ox Blood Cells	0.01454

SOLUBILITY OF HYDROGEN IN WATER AND IN RUBBER.

(Venable and Fuwa, 1922.)

The gas dissolved by a given amount of air free rubber was pumped out with a Töpler pump and measured over mercury.

100 cc. H₂O dissolve 1.8 cc. hydrogen (reduced to 0° and 760^{mm}) at 21°.
 » Rubber » less than 1.0 cc. (» » ») » .

RATIO OF THE SOLUBILITY OF HYDROGEN IN WATER TO ITS SOLUBILITY IN AQUEOUS SOLUTIONS OF SUCROSE AT 13°.

(Garner and Masson, 1921.)

Mols. sucrose per liter.....	0.292	0.585	0.877	1.169	1.460	1.755
Ratio, H ₂ in H ₂ O ÷ H ₂ in aq. sucrose.	1.11	1.23	1.39	1.61	1.87	2.17

SOLUBILITY OF A MIXTURE OF 3 VOLUMES OF HYDROGEN + 1 VOLUME OF NITROGEN IN LIQUID AMMONIA. (Larson and Black, 1925.)

		Cc. Gas (at standard temp-and pressure) dissolved by 1.0 gm. liquid Ammonia		
Total Pressure.	t°.	H ₂ .	N ₂ .	Total.
50 atmospheres.....	-25.2	1.62	0.73	2.35
»	-18.5	1.90	0.84	2.74
»	-10.0	2.07	0.94	3.01
»	- 3.0	2.35	1.08	3.43
»	0.0	2.61	1.15	3.76
»	+ 2.5	2.70	1.19	3.89
»	19.0	3.19	1.46	4.65
100 atmospheres.....	-25.0	3.30	1.35	4.65
»	-20.0	3.66	1.46	5.12
»	-16.5	3.85	1.63	5.48
»	-10.0	4.43	1.83	6.26
»	- 5.2	4.84	2.02	6.86
»	0.0	5.28	2.28	7.56
»	+22.0	7.54	3.21	10.75
150 atmospheres.....	-22.0	4.70	1.89	6.59
»	-17.2	5.12	2.09	7.21
»	- 9.2	6.20	2.44	8.64
»	- 7.2	6.30	2.58	8.88
»	+ 5.0	8.22	3.33	11.55
»	13.3	9.42	3.61	13.03

SOLUBILITY OF HYDROGEN IN LIQUID AMMONIA AT SEVERAL
TEMPERATURES AND AT PRESSURES UP TO 1000 ATMOSPHERES.

(Wiebe and Tremearne, 1934; Wiebe and Gaddy, 1937.)

The steel tube bubbling apparatus previously described for the solubility of H in Water was used. The H_2 contained 0.1% N_2 and the NH_3 contained 0.02% H_2O . No correction was made for these impurities. The values are believed to be accurate to within 2-3 parts per 1000.

Total Pressure in Atmospheres	cc H_2 (reduced to 0° and 760mm) dissolved by 1.0 gm. NH_3 at:				
	0°	25°	50°	75°	100°
25	—	1.695	0.85	—	—
50	3.28	4.47	5.10	3.49	—
75	—	7.20	9.33	9.95	5.80
100	6.70	9.88	13.49	16.35	15.67
150	—	15.08	21.60	29.00	36.35
200	13.11	20.08	29.39	41.41	57.10
300	18.96	29.45	44.42	65.40	98.74
400	24.33	38.13	58.33	88.34	140.60
500	29.27	46.18	71.33	110.22	182.4
600	33.99	53.71	83.48	131.0	224.0
700	38.25	60.77	94.82	150.6	264.3
800	42.33	67.63	105.4	169.2	305.2
900	46.20	73.74	115.3	186.8	346.5
1000	49.77	79.25	124.9	203.3	388.2

H

Ipatjew, and Theodorowitch, 1932, give results for the solubility of H_2 in liquid NH_3 at 25° and at pressures up to 250 atmospheres which are somewhat lower than the above over their whole range.

SOLUBILITY OF HYDROGEN IN RUSSIAN PETROLEUM.

(Gniewasz and Walfisz, 1887.)

Coefficient of absorption at 20° = 0.0582, at 10° = 0.0652.

SOLUBILITY OF HYDROGEN IN WATER AND IN ORGANIC SOLVENTS.

Results in terms of the Ostwald Expression,

(Just, 1901.)

Solvent.	l_{25} .	l_{20} .	Solvent.	l_{25} .	l_{20} .
Water	0.0199	0.0200	Amyl Acetate	0.0774	0.0743
Aniline	0.0285	0.0303	Xylene	0.0819	0.0783
Amyl Alcohol	0.0301	0.0353	Ethyl Acetate	0.0852	0.0788
Nitrobenzene	0.0371	0.0353	Toluene	0.0874	0.0838
Carbon Disulfide	0.0375	0.0336	Ethyl Alcohol (98.8%)	0.0804	0.0862
Acetic Acid	0.0633	0.0617	Methyl Alcohol	0.0945	0.0902
Benzene	0.0756	0.0707	Isobutyl Alcohol	0.0976	0.0929
Acetone	0.0764	0.0703			

SOLUBILITY OF HYDROGEN IN ETHYL ETHER.

(Christoff, 1912.)

Results in terms of the Ostwald Solubility Expression l

$$l_0 = 0.1115, \quad l_5 = 0.1150, \quad l_{10} = 0.1195, \quad l_{15} = 0.1259.$$

Results for the system, Hydrogen + Nitrogen + Ammonia (gas) + Ammonia (Liquid) at temperatures from -22.5° to $+18.7^{\circ}$ and pressures from 50 to 1000 atmospheres are given by Larson and Black, 1925. A discussion of these and similar results for other systems in light of the concept that solubility effect is a change in activity of one component resulting from the presence of the other component is given by Cupples, 1929.

H HYDROGEN

SOLUBILITY OF HYDROGEN IN SEVERAL SOLVENTS.

(Horiuti, 1931.)

The determinations were made with great precision. The results are in terms of the Ostwald Solubility Expression, which is l = the ratio of the concentration of the hydrogen in the liquid phase to its concentration in the gas phase.

Results for:

Carbon Tetrachloride

t°	l
0	0.0650
20.9	0.0794
38.8	0.0928
59.0	0.1124

Benzene

t°	l
7.0	0.0585
22.9	0.0700
41.3	0.0844
62.8	0.1051

Ethyl Ether

t°	l
-80.6	0.0498
-59.9	0.0632
-40.0	0.0800
-21.1	0.0964
0.0	0.1188
21.1	0.1409

Acetone

t°	l
-81.9	0.0273
-60.7	0.0376
-40.6	0.0498
-20.9	0.0618
0.0	0.0783
20.9	0.0968
40.0	0.1131

Chlorobenzene

t°	l
-40.9	0.0303
-20.5	0.0382
0.0	0.0479
21.2	0.0595
40.0	0.0702
60.3	0.0837
80.8	0.0976

Methyl Acetate

t°	l
-78.5	0.0249
-60.3	0.0338
-40.1	0.0447
-20.1	0.0578
0.0	0.0730
20.9	0.0891
40.90	0.1051

SOLUBILITY OF HYDROGEN IN SEVERAL SOLVENTS.
(Maxted and Moon, 1936.)

Some of the determinations were made with an apparatus with a magnetically operated stirrer such as employed by Horiuti. For the others a form of apparatus which permitted stirring by rocking the mixture was employed.

Solvent	t°	d. of Solvent at Solution Temp.	Vapor Pressure (mm Hg) of Solvent at Solution Temp.	H ₂ solubility expressed as Bunsen Abs. Coef.
Acetic Acid	18.6	1.0507	11.0	0.0558
" "	20.0	1.049	12.0	0.0566
" "	30.0	1.039	21.0	0.0594
" "	37.5	1.031	30.0	0.0620
" "	45.0	1.023	45.0	0.0649
" "	54.9	1.011	72.0	0.0676
" "	64.8	1.000	109.0	0.0714
" "	74.8	0.989	166.0	0.0742
Ethyl Alcohol	0.6	0.8063	12.2	0.0718
" "	10.0	0.7978	23.8	0.0737
" "	20.3	0.7890	44.0	0.0769
" "	25.0	0.7851	60.0	0.0784
" "	30.0	0.7808	78.0	0.0802
" "	40.0	0.7730	133.0	0.0840
" "	50.0	0.7633	220.0	0.0864
Ethyl Acetate	0.5	0.9244	25.0	0.0708
" "	10.0	0.9126	42.7	0.0724
" "	21.0	0.8993	76.9	0.0761
" "	30.0	0.8883	118.7	0.0808
" "	39.8	0.8762	184.0	0.0803
Chloroform	1.0	1.5260	61.0	0.0563
" "	10.0	1.5050	100.0	0.0576
" "	18.7	1.4886	149.6	0.0584
" "	25.5	1.4750	197.0	0.0614
Benzene	0.5	0.9001	25.0	0.0526
" "	8.3	0.8920	43.0	0.0572
" "	21.2	0.8775	79.0	0.0625
" "	30.6	0.8675	123.0	0.0672
" "	40.0	0.8576	181.1	0.0727

HYDROGEN

SOLUBILITY OF HYDROGEN IN SEVERAL SOLVENTS.
(Kirjeew and Romantchouk, 1936.)

Solvent	Total Gas Pressure in mm. Hg.	cc H ₂ (reduced to 0 and 760mm) dissolved by 1 cc Solvent at:				
		-20°	-10°	0°	+20°	+40°
Petrol (Gasoline?)	50	0.010	0.008	0.007	0.005	0.004
"	100	0.019	0.016	0.014	0.010	0.008
"	200	0.038	0.034	0.028	0.021	0.017
"	300	0.056	0.051	0.043	0.033	0.025
"	400	0.074	0.068	0.057	0.044	0.034
"	500	0.092	0.085	0.072	0.054	0.042
"	600	0.111	0.102	0.087	0.065	0.050
"	700	0.129	0.119	0.101	0.076	0.058
"	760	0.140	0.129	0.110	0.083	0.064
Xylene	50	0.006	0.005	—	—	—
"	100	0.013	0.011	0.009	0.009	0.010
"	200	0.026	0.024	0.018	0.018	0.021
"	300	0.039	0.036	0.029	0.029	0.033
"	400	0.052	0.048	0.039	0.039	0.044
"	500	0.065	0.060	0.046	0.049	0.056
"	600	0.078	0.072	0.059	0.059	0.067
"	700	0.091	0.084	0.069	0.069	0.078
"	760	0.099	0.091	0.075	0.075	0.085
"Cracking Benzene(?)	50	0.014	0.012	0.010	0.008	0.005
"	100	0.028	0.022	0.018	0.016	0.010
"	200	0.058	0.044	0.036	0.030	0.020
"	300	0.087	0.064	0.056	0.044	0.030
"	400	0.116	0.084	0.074	0.059	0.040
"	500	0.146	0.105	0.094	0.074	0.051
"	600	0.175	0.126	0.112	0.088	0.061
"	700	0.202	0.148	0.132	0.102	0.072
"	760	0.220	0.160	0.144	0.111	0.078

Results are also given for Dichlor Ethane and "Heavy Solvent" which are fairly near those for "Cracking Benzene" at 20°.

1 liter Cyclo hexanol (C₆H₁₁OH) dissolve 83.1cc H₂ at 20° and 760mm pressure.
(Camquill, 1927.)

SOLUBILITY OF HYDROGEN IN SEVERAL SOLVENTS AT 25° AT HIGH PRESSURES.
(Frolich, Touch, Hogan and Peer, 1931.)

The determinations were made by shaking the solvent with various pressures of hydrogen in a steel cylinder maintained at 250, and after attainment of equilibrium, withdrawing a sample of the saturated solution over mercury, in a buret designed so that the volumes could be measured with the same degree of accuracy at any ratio of gas to liquid. The results are presented in the form of a diagram from which the following approximated values were estimated.

Solvent	cc H ₂ (measured at 25° and 760mm) dissolved by 1.0cc Solvent at:				
	40	60	80	100	150 Atmospheres Pressure
Methyl alcohol	3.3	5.0	7.0	8.5	12.5
Propane	17.3	25.0	34.0	42.5	—
iso Propanol	2.5	4.5	6.0	7.5	11.3
Pentane	9.0	13.5	18.2	22.5	—
Butane	11.0	16.5	22.0	27.0	—
Hexane	5.0	11.0	15.0	18.0	—
Octane	6.0	8.5	11.5	14.9	22.0
Cyclohexane	4.0	6.0	8.0	60.0	15.2
Heavy Naphtha	2.7	4.3	5.6	7.3	10.8
Gas Oil	2.5	4.0	5.3	6.8	10.0

DATA FOR THE SOLUBILITY OF HYDROGEN IN THE FOLLOWING METALS
HAVE BEEN DETERMINED.

Ag (Steacie and Johnson, 1928.)	Mo (Martin, 1929.)
Ce (von Samson-Himmelstjerna, 1930.)	Nb (Hagen and Sieverts, 1930.)
Co (Sieverts, 1907; Sieverts and Hagen, 1934.)	Ni (Sieverts, 1911; Luckemeyer-Hasse and Shenk, 1932.)
Cr (Martin, 1929; Tamman, 1930; Luckemeyer-Hasse and Shenk, 1932.)	Pd (Sieverts, 1914; von Samson-Himmelstjerna, 1930; Sieverts and Zapf, 1935, also give results for the Solubility of Deuterium.)
Cu (Sieverts, 1911.)	Pt (Sieverts and Jurisch, 1912.)
Fe (Sieverts, 1911; Martin, 1929; Sieverts and Hagen, 1931; Luckemeyer-Hasse and Shenk, 1932.)	Ti (Hagen and Sieverts, 1930; Kirschfeld and Sieverts, 1929.)
(Sieverts, Zapf and Moritz, 1938.)	V (Kirschfeld and Sieverts, 1929; 1930.)
Ge (Hagen and Sieverts, 1930.)	W (Martin, 1929.)
In (" " " ")	
La (von Samson-Himmelstjerna, 1930.)	
Mn (Luckemeyer-Hasse and Schenk, 1932.)	

HYDROGEN BORATE H_3BO_3 (See Boron Oxide Hydrate)

HYDROGEN BROMIDE (Hydrobromic Acid) HBr

H HYDROGEN HYDROGEN BROMIDE

568

SOLUBILITY IN WATER.

(Roozeboom — Z. physik. Chem. 2, 454, '88; Rec. trav. chim. 4, 107, '85; 5, 358, '86; see also Pickering — Phil. Mag. [5] 36, 119, '93.)

t°.	Gms. HBr Dissolved (at 760-765mm.) per 100 Gms.		β .	Gms. HBr Dissolved at Lower Pressures per 100 Gms. H ₂ O.
	Water.	Solution.		
- 2.5	255.0	71.83	..	175.0 (10 mm.)
- 15	239.0	70.50	...	...
0	221.2	68.85	611.6	...
+ 10	210.3	67.76	581.4	108.5 (5 mm.)
15	204.0	67.10	...	...
25	193.0	65.88	532.1	...
50	171.5	63.16	468.6	...
75	150.5	60.08	406.7	...
100	130.0	56.52	344.6	...

β = Bunsen Absorption Coefficient which is the volume of gas (reduced to 0 and 760mm) absorbed by 1 volume of the liquid when the pressure of the gas itself, without the tension of the liquid, amounts to 760mm.

Br EQUILIBRIUM IN THE SYSTEM HYDROBROMIC ACID, WATER AND ALCOHOLS AT 25°. (Reburn and Shearer, 1933.)

The determinations were made by adding from a buret one of the constituents to known mixtures of the other two until appearance of permanent turbidity. The tie lines of the saturation curve thus obtained were determined by mixing suitable amounts of the three constituents to yield two liquid layers at 25° and titrating each of these for HBr content.

Results for HBr + H₂O + Iso Amyl Alcohol, (CH₃)₂CHCH₂CH₂OH Results for HBr + H₂O + Iso Butyl Alcohol, (CH₃)₂CHCH₂OH

Gms. per 100
Gms. sat. sol.
H₂O C₅H₁₂O

9.0 91.0
11.36 85.3
16.90 76.8
17.7 70.6
21.2 63.2
26.4 57.6
28.4 47.8
30.2 44.2

Gms. per 100
Gms. sat. sol.
H₂O C₅H₁₂O

42.0 25.0
45.8 19.1
54.7 8.17
67.7 3.39
76.9 3.00
83.0 2.84
91.7 2.58
97.0 3.00

Gms. per 100
Gms. sat. sol.
H₂O C₄H₁₀O

16.1 83.9
22.6 72.7
29.1 61.8
35.1 53.1
48.9 35.0
57.3 25.7

Gms. per 100
Gms. sat. sol.
H₂O C₄H₁₀O

62.4 20.0
66.9 15.4
70.8 12.6
75.5 11.0
82.8 8.7
91.2 8.8

Tie Line Data

Gms. HBr per 100 gms.
H₂O layer C₅H₁₂O layer

13.5 3.5
24.0 13.0
34.1 23.5

Tie Line Data

Gms. HBr per 100 gms.
H₂O layer C₄H₁₀O layer

10.8 6.0
8.7 4.3

FREEZING-POINTS OF DILUTE AQUEOUS HYDROBROMIC ACID SOLUTIONS.

(Klein and Svanberg, 1920.)

t° of F. pt	Normality of Aq. HBr
-0.362	0.1
-0.923	0.25
-1.907	0.5

Freezing-point data are given for mixtures of HBr and each of the following compounds.

1. OH (1)	(C ₂ H ₅) ₂ O (3)	C ₆ H ₅ C ₂ H ₅ (2)
2. H ₂ SO ₄ (1)	C ₃ H ₄ (4)	C ₆ H ₅ C ₃ H ₇ (5)
3. CH ₃ COOH (2)	CH ₃ COCH ₃ (1)	C ₇ H ₄ (5)
4. C ₂ H ₅ Cl (1)	CH ₃ COOC ₂ H ₅ (1)	C ₆ H ₄ (CH ₃) ₂ m p (5)
5. S ₂ O ₃ (1)	C ₆ H ₆ (1)	C ₉ H ₁₂ (2)
6. C ₂ Cl ₄ (1)	C ₆ H ₅ CH ₃ (1)(2)	H ₂ S (6)
	C ₆ H ₃ (CH ₃) ₃ (s) (2)	

(1) = Maass and McIntosh, 1912; Reid and McIntosh, 1916; (2) = Maass and Russell, 1918; (3) McIntosh, 1911; (4) Maass and Russell, 1921; (5) Maass, Omer and Morrison, 1923; (6) Bagster, 1911.

HYDROGEN CYANIDE HCN

CN

FREEZING-POINTS OF MIXTURES OF HYDROGEN CYANIDE AND WATER.

(Coates and Hartshorne, 1931.)

The apparatus was provided with a magnetically operated stirrer. A mercury thermometer was used and the freezing-points determined by back extrapolation of time-temperature curves over the super cooling region kept near the eutectic point. Here it was necessary to employ a jet of air directed a short distance above the level of the liquid. The rapid evaporation thus induced caused crystals to form which inoculated the mixture and prevented super cooling. The mixtures of which the freezing-points were determined were analyzed by Liebig's method of silver nitrate titration. The results in the metastable region were obtained by a modified form of apparatus in which stirring was avoided and a rapid rate of cooling was employed.

Gm. Mols. HCN per 100 gm. Mols. HCN + H ₂ O		Solid Phase	t°	Gm. Mols. HCN per 100 gm. Mols. HCN + H ₂ O		Solid Phase	t°	Gm. Mols. HCN per 100 gm. Mols. HCN + H ₂ O		Solid Phase
0.9	0.81	Ice	-16.4	50.29	Ice		-15.8	95.9		HCN
3.5	3.09	"	-17.3	59.24	"		-14.4	98.5		"
7.7	7.76	"	-19.3	66.96	"		-13.3	100.0		"
9.9	9.89	"	-21.1	70.4	"		-24.7	24.8*		
12.8	14.25	"	-22.6	73.0	"		-24.0	34.4*		
14.5	19.36	"	-23.4	74.5	" + HCN		-24.1	39.2*		
15.5	26.29	"	-22.5	79.7	HCN		-24.5	47.9*		
16.0	36.82	"	-19.4	88.9	"		-25.6	54.7*		
							-27.5	58.7*		

Metastable region - consisting of two liquid phases with critical solution temp. of -24.0°.

Additional determinations in agreement with the above are given by Cooper and Coffin, 1933. These investigators also give results for the freezing points of mixtures of HCN + HCOOH, HCN + HCONH₂ and HCN + C₆H₅CNO.

HYDROCYANIC ACID HCN.

DISTRIBUTION BETWEEN WATER AND BENZENE.
(Hantzsch and Seibalt, 1899; Hantzsch and Vagt, 1901.)

t°.	Mol. HCN per Liter:		$\frac{c}{c'}$	t°.	Mol. HCN per Liter:		$\frac{c}{c'}$
	H ₂ O Layer (c).	C ₆ H ₆ Layer (c').			H ₂ O Layer (c).	C ₆ H ₆ Layer (c').	
6	0.00625	0.00325	1.923	7	0.0574	0.0148	3.88
16	0.00593	0.00363	1.634	20	0.0572	0.0154	3.72
25	0.00580	0.00375	1.547				

Data for the effect of HCl and of KCl on the distribution are also given.

DISTRIBUTION OF HYDROGEN CYANIDE BETWEEN WATER AND BENZENE.
(Gross and Schwarz, 1930.)

t°	Gm. Mols. HCN per 1000cc:		t°	Gm. Mols. HCN per 1000cc:		t°	Gm. Mols. HCN per 1000cc:	
	H ₂ O layer	C ₆ H ₆ layer		H ₂ O layer	C ₆ H ₆ layer		H ₂ O layer	C ₆ H ₆ layer
15	0.01084	0.002665	15	0.3494	0.0905	15	0.5532	0.1486
"	0.02167	0.005342	"	0.3777	0.0981	"	0.6507	0.1772
"	0.04334	0.01073	"	0.3999	0.1051	"	0.9178	0.2598
"	0.2321	0.05916	"	0.4740	0.1254	8.0	0.4123	0.1053
"	0.2905	0.0749	"	0.4830	0.1275	8.3	0.4203	0.1079
"	0.3214	0.0828	"	0.4933	0.1307	8.3	0.7789	0.2089

CN

The authors also give results for the distribution of HCN at 15° between Benzene and aqueous solutions of KCl, KNO₃, CsNO₃, NaNO₃, LiNO₃, urea and glycerol. Results are given by Gross and Iser, 1930 for the distribution of HCN at 15° between Benzene and aqueous solutions of LiCl, NaCl, NaNO₃, K₂SO₄, MgCl₂, MgSO₄ and La₂(SO₄)₃. Results are given by Randall and Halford, 1930, for the distribution of HCN at 25° between Benzene and aqueous solutions of Hydrogen Silver Cyanide (HAg(CN)₂).

HYDROGEN CYANATE (Cyanic Acid) HCNO

SOLUBILITY OF HYDROGEN CYANATE IN WATER DETERMINED
BY THE FREEZING-POINT METHOD.

(Linhard, 1938.)

CNO

Although cyanic acid decomposes in presence of water it was found that mixtures of the two are stable at sufficiently low temperatures and the following results were obtained for the freezing-point curve.

t°(cor.)	Mols. HCNO per 100 Mols. HCNO + H ₂ O	Solid Phase	t°(cor.)	Mols. HCNO per 100 Mols. HCNO + H ₂ O	Solid Phase
-23.5	29.3	H ₂ O (Ice)	-68.8	58.5	H ₂ O
-28.7	33.3	"	-83.6	62.8	"
-33.7	38.3	"	-102.5	67.0	" + HCNO
-39.6	43.2	"	-101.0	68.1	HCNO
-42.2	45.0	"	-97.2	74.9	"
-50.0	49.8	"	-93.2	83.6	"
-62.0	55.3	"	-86.8 m. pt.	100.0	"

HYDROCHLORIC ACID HCl.

SOLUBILITY IN WATER BY THE FREEZING-POINT METHOD.

(Composite curve from results of Roloff, 1895; Pickering, 1893(a); Roozeboom, 1884, 1889 and Rupert, 1909.)

t°.	Gms. HCl per 100 Gms. Sat. Sol.	Solid Phase.	t°.	Gms. HCl per 100 Gms. Sat. Sol.	Solid Phase.
-1.706	1.66	Ice	-18.4	48.6	HCl ₂ H ₂ O
-14.97	10.02	"	-17.7 m. pt.	50.3	"
-28.84	14.51	"	-18.7	52.85	"
-40	17.40	"	-19.4	54.1	"
-60	21.30	"	-20.8	55.7	"
-80	24.20	"	-21.3	56.5	"
-86 Eutec.	24.8	" + HCl ₃ H ₂ O	-23.2	57.3	"
-50	30.1	HCl ₃ H ₂ O	-23.5 Eutec.	...	" + HCl ₂ H ₂ O
-40	32.7	"	-21.5	58.2	HCl ₂ H ₂ O
-30	36.5	"	-20.7	59.1	"
-24.9 m. pt.	40.3	"	-18.4	61.1	"
-27.5	44	" + HCl ₂ H ₂ O	-17.4	62.4	"
-23.8	45.7	HCl ₂ H ₂ O	-15.4	65.4	"
-21.2	45.9	"	-15.35	66.8	"

At about -15.35 two liquid layers are formed. Data for these are as follows:

Cl

HCl layer.

H₂O layer.

t° of Saturation	Gms. H ₂ O per 100 Gms. Sat. Sol.	t°.	Gms. HCl per 100 Gms. Sat. Sol.	d. of Sat. Sol.	t°.	Gms. HCl per 100 Gms. Sat. Sol.	d. of Sat. Sol.
Below -50	0.008	-20	67.65	1.279	15	64.70	1.231
" -50	0.017	-15	67.29	1.269	20	64.19	1.228
Bet. -15 and 0°	0.077	-10	66.71	1.260	30	63.21	1.229
Above 45	0.021	-5	66.44	1.255	35	62.90	1.227
"	0.052	0	65.85	1.247	40	62.27	1.218
"	0.11	+5	65.48	1.245	45	61.76	1.212
"	0.13	10	65.18	1.240	50	61.65	1.219

For additional data on this system see Baume and Tykociner, 1914.

FREEZING-POINTS OF DILUTE AQUEOUS HYDROCHLORIC ACID SOLUTIONS.

(Chadwell, 1927.)

The determinations were made with the highest possible precision. A platinum thermometer and Wheatstone bridge were used for measuring the temperatures. The analyses were made upon solutions in contact with a large amount of added ice.

F. pt. lowering below 0° C	Gm. Equiv. HCl per 1000 gms. H ₂ O	F. pt. lowering below 0° C	Gm. Equiv. HCl per 1000 gms. H ₂ O
-0.2934	0.08321	-2.3664	0.6363
-0.5033	0.1427	-2.5465	0.6785
-0.7145	0.2024	-2.6114	0.6969
-0.7771	0.2198	-2.9420	0.7736
-0.8440	0.2374	-3.1219	0.8187
-1.1000	0.3080	-3.4545	0.8945
-1.1202	0.3137	-3.8192	0.9765
-1.4738	0.4082	-4.0721	1.0324
-1.9344	0.5275		

A compilation of the available data upon the partial vapor pressure of aqueous solutions of hydrochloric acid is given by Zeisberg, 1925.)

FREEZING-POINTS OF DILUTE AQUEOUS HYDROCHLORIC ACID SOLUTIONS.
(Klein and Svanberg, 1920.)

t° of F. pt.

Normality of HCl

-0.34

0.1

-0.876

0.25

-1.807

0.5

HYDROCHLORIC ACID HCl.

SOLUBILITY IN WATER AT DIFFERENT TEMPERATURES AND PRESSURES.

(Deicke; Roscoe and Dittmar — Liebig's Ann. 112, 334, 59; below 0°, Roozeboom — Rec. trav. chim. 3, 104, '84.)

t°.	At Different Temperatures and 760 mm. Pressure.				At Different Pressures and 0°	
	cc. HCl per 100 cc. H ₂ O.	Density.	Gms. HCl per 100 g. Sol.	Gms. HCl per 100 g. H ₂ O.	Pressures.*	Gms. HCl per 100 g. H ₂ O
0	525.2	1.2257	45.15	82.31	60	61.3
4	497.7	1.2265	44.36	79.73	100	65.7
8	480.3	1.2185	43.83	78.03	150	68.6
12	471.3	1.2148	43.28	76.30	200	70.7
14	462.4	1.2074	42.83	74.92	300	73.8
18	451.2	1.2004	42.34	73.41	400	76.3
23	435.0	1.2014	41.54	71.03	500	78.2
30	...	..	40.23	67.3	600	80.0
40	...	...	38.68	63.3	750	82.4
50	...	...	37.34	59.6	1000	85.6
60	...	...	35.94	56.1	1300	89.5

* Pressures in mm. Hg minus tension of H₂O vapor.

100 gms. sat. sol. of HCl in H₂O contain 45.44 gm. HCl at 0° and 41.2 gm. at 25°. (Cupr, 1926, 1928.)

100cc sat. sol. of HCl in H₂O contain 71.9 gm. HCl at 20°. (Knight and Hinshelwood, 1927.)

SOLUBILITY IN WATER AT TEMPERATURES BELOW 0°.

At a pressure of 760 mm.				At pressures below and above 760 mm.			
t°.	g.	t°.	g.	t°.	mm. Pressure.	g.	
-24	101.2	-15	93.3	-23.8	...	84.2	
-21	98.3	-10	89.8	-21	334	86.8	
-18.3	96	-5	86.8	-19	580	92.6	
-18	95.7	0	84.2	-18	900	98.4	
				-17.7	1073	101.4	

The eutectic is at -86° and 33 gms. HCl per 100 gms. H₂O.

g = the weight of HCl gas in grams dissolved by 100 grams of H₂O at the indicated temperature and at a total pressure (that is the partial pressure of the gas plus the vapor pressure of the liquid at the absorption temperature) of 760mm.Hg.

Data for the solubility at 25° of HCl gas in water at low pressures are given by Dobson and Masson, 1924.

SOLUBILITY OF HYDROCHLORIC ACID GAS IN AQUEOUS SULFURIC ACID SOLUTIONS.
(Coppadoro, 1909.)

Results at 17°.			Results at 40°.			Results at 70°.		
d of Sat. Sol.	Gms. per 100 Gms. Sat. Sol.		d of Sat. Sol.	Gms. per 100 Gms. Sat. Sol.		d of Sat. Sol.	Gms. per 100 Gms. Sat. Sol.	
	H ₂ SO ₄ .	HCl.		H ₂ SO ₄ .	HCl.		H ₂ SO ₄ .	HCl.
I. 211	0	42.7	I. 185	3.56	35.6	I. 145	1.61	32.7
I. 220	1.86	39.9	I. 195	5.86	34.8	I. 150	3.38	31.1
I. 220	4.75	39.2	I. 210	8.90	32.4	I. 160	4.80	30.5
I. 235	8.04	36.9	I. 255	16.80	27.6	I. 180	7.93	28.9
I. 260	12.80	33.2	I. 255	18.8	25.9	I. 225	18.9	22.8
I. 305	20.9	28.5	I. 340	28.6	18.5	I. 230	20	22.3
I. 355	30.8	22.6	I. 400	44.2	11.5	I. 315	36.2	13.2
I. 430	44.6	15	I. 520	61.1	3.35	I. 380	48	6.99
I. 545	59.4	6.26	I. 575	66.4	1.17	I. 510	62.7	1.56
I. 580	65.4	3.25	I. 650	73.2	0.17	I. 560	67.6	0.54
I. 660	73.7	0.62	I. 725	79.4	0.081	I. 700	80.7	0.05
I. 735	77.5	0.11	I. 755	81.4	0.032	I. 745	83	0.035
I. 815	89	0.068	I. 770	83.5	0.029	I. 745	83.4	0.032

SOLUBILITY OF HYDROCHLORIC ACID IN CONCENTRATED SULFURIC ACID

AT 25° AND 760mm.

(Cupr, 1925.)

C1

Percent H ₂ SO ₄	Gm. HCl per 100 gms. sat. sol.	Percent H ₂ SO ₄	Gm. HCl per 100 gms. sat. sol.	Percent H ₂ SO ₄	Gm. HCl per 100 gms. sat. sol.
76.43	0.3588	90.69	0.0922	97.36	0.1432
81.87	0.1420	92.20	0.0996	98.65	0.1971
86.76	0.0974	94.14	0.1082	100.00	0.4015
89.31	0.0920				

Additional determinations at other temperatures and concentrations of H₂SO₄ are given by Cupr, 1925(a), 1928.

SOLUBILITY OF HYDROCHLORIC ACID IN AQUEOUS SOLUTIONS OF ACETIC ACID.

Results at 0° (Cupr, 1926, 1928.)

Results at 25°

Gms. CH ₃ COOH per 100 gms. aq. Solvent	Gms. HCl per 100 gms. aq. Solvent	cc HCl gas per 1.0cc sat. sol. at 760mm	Gms. CH ₃ COOH per 100 gms. aq. Solvent	Gms. HCl per 100 gms. aq. Solvent	cc HCl gas per 1.0cc sat. sol. at 760mm
11.52	76.51	479.2	11.02	63.03	390.2
19.03	72.72	461.2	22.90	55.45	349.8
27.96	66.98	430.8	33.69	51.06	325.8
48.89	55.69	366.6	48.38	42.67	275.7
72.96	41.41	276.7	70.95	30.66	200.4
79.86	37.51	251.0	87.04	21.32	139.1
89.56	31.48	210.3	95.24	14.13	91.5
89.49	31.39	209.0	99.45	8.35	53.6

MISCIBILITY OF HYDROCHLORIC ACID WITH MIXTURES OF WATER AND PHENOL AT 12°.

(Schreinemakers and van der Horn van der Bos, 1912.)

Composition of the Reciprocally Saturated Liquid Pairs.				Composition of the Solutions in Contact with Solid Phenol.		
Water Rich Layer.		Phenol Rich Layer.		% Water.	% HCl.	% Phenol.
% HCl.	% Phenol.	% HCl.	% Phenol.			
0	7.45	0	72	11.22	0	88.78
3.1	6.6	0.09	78	84.5	10.7	4.8
6.6	5.3	0.2	80.3	80.38	15.64	3.98
8	5.1	0.36	82.6	72.43	24.37	3.2
10.7	4.8	0.52	84.5	60.25	36.25	3.5

Additional data for this system are given by Krug and Cameron, 1900.

HYDROGEN CHLORIDE

EQUILIBRIUM IN THE SYSTEMS HYDROCHLORIC ACID, WATER AND ORGANIC SOLVENTS.
(Reburn and Shearer, 1933.)

The determinations were made by adding from a buret, one of the constituents to known mixtures of the other two until appearance of a permanent turbidity. The tie lines of the saturation curve thus obtained were determined by mixing suitable amounts of the three constituents to yield two liquid layers and titrating each of these for acid content.

Results at 25° for HCl + H₂O + Iso Amyl Alcohol ((CH₃)₂CHCH₂CH₂OH) Results at 25° for HCl + H₂O + Iso Butyl Alcohol ((CH₃)₂CHCH₂OH) Results at 25° for HCl + H₂O + Cyclohexanone CO(CH₂)₄CH₂

Gms. per 100 gms. sat. sol.
H₂O C₅H₁₂O

8.9	91.1
14.15	82.7
18.90	74.6
23.10	67.7
38.8	44.1
49.5	29.8
54.3	23.6
64.9	11.3
72.0	5.16
83.6	3.60
91.4	2.79
97.1	2.90

Gms. per 100 gms. sat. sol.
H₂O C₄H₁₀O

16.1	83.9
27.3	68.4
35.4	58.3
40.0	52.3
44.6	46.6
49.6	40.0
53.2	36.7
59.2	30.0
69.5	18.7
79.8	10.3
84.8	8.4
91.2	8.8

Gms. per 100 gms. sat. sol.
H₂O C₆H₁₀O

7.5	92.5
22.1	74.4
34.6	59.8
43.4	49.6
50.2	41.9
54.4	36.9
56.5	34.0
62.8	27.0
68.1	21.7
72.8	17.2
81.4	12.3
87.8	12.2

Tie Line Data

Gms. HCl per 100 gms.
H₂O C₅H₁₂O
layer layer

7.83	1.99
16.13	7.30
21.7	14.7

Tie Line Data

Gms. HCl per 100 gms.
H₂O C₄H₁₀O
layer layer

10.4	6.3
7.7	3.6
4.2	1.3

Tie Line Data

Gms. HCl per 100 gms.
H₂O C₆H₁₀O
layer layer

9.5	2.3
8.8	1.1

Results at 40° for HCl + H₂O + Iso Butyl Alcohol ((CH₃)₂CHCH₂OH)

Gms. per 100 gms. sat. sol.
H₂O C₄H₁₀O

17.9	82.1
26.6	69.6
42.6	49.3
53.5	36.9
64.0	25.0
74.0	14.7
81.2	10.0
92.0	8.0

Results at 55° for HCl + H₂O + Iso Butyl Alcohol ((CH₃)₂CHCH₂OH)

Gms. per 100 gms. sat. sol.
H₂O C₄H₁₀O

21.8	78.2
29.2	67.2
37.0	56.8
50.6	40.5
64.3	24.8
72.4	16.6
80.7	10.5
91.2	8.8

Results at 25° for HCl + H₂O + n Butyl Alcohol (CH₃(CH₂)₃CH₂OH)

Gms. per 100 gms. sat. sol.
H₂O C₄H₁₀O

21.9	78.1
29.2	67.1
39.7	54.3
51.9	39.4
66.4	23.3
75.4	13.9
84.9	8.5
91.7	8.3

DISTRIBUTION OF HYDROCHLORIC ACID BETWEEN WATER AND BENZENE.

Results at 20°
(Knight and Hinshelwood, 1927.)

Results at 25°
(Wynne-Jones, 1930.)

Gms. HCl per 1000cc		Gms. HCl per 1000cc		Gms. HCl per 1000cc		Gm. Mols. HCl per 1000 gms.:	
H ₂ O layer	C ₆ H ₆ layer	H ₂ O layer	C ₆ H ₆ layer	H ₂ O layer	C ₆ H ₆ layer	H ₂ O layer	C ₆ H ₆ layer
718.8	18.50	420.2	2.47	212.0	0.252	9.603	0.00213
604.0	17.7	379.8	1.818	165.9	0.100	10.215	0.00340
549.3	17.4	343.3	1.264	134.0	0.056	10.508	0.00423
509.0	15.7	312.0	0.929	94.8	0.028	11.43	0.00768
504.6	15.62	289.3	0.706	43.3	0.0036	11.99	0.0110
492.5	8.92	259.0	0.532	19.5	0.0002	12.93	0.0216
448.5	3.72	236.1	0.382	12.3	0.0001		

1000cc pure benzene dissolve 16.8 gm. HCl at 20° and 760mm pressure.

1000cc benzene previously saturated with H₂O dissolve 18.31 gms. HCl at 20° and 760mm.

1000cc benzene simultaneously saturated with H₂O and HCl dissolve 18.50 gms. HCl at 20° and 760mm. (Knight and Hinshelwood, 1927.)

DISTRIBUTION OF HYDROCHLORIC ACID BETWEEN WATER AND NITRO BENZENE AT 25°.
(Wynne-Jones, 1930.)

Gm. Mols. HCl per 1000 gms.		Gm. Mols. HCl per 1000 gms.		Gm. Mols. HCl per 1000 gms.	
H ₂ O layer	C ₆ H ₅ NO ₂ layer	H ₂ O layer	C ₆ H ₅ NO ₂ layer	H ₂ O layer	C ₆ H ₅ NO ₂ layer
9.635	0.0027	14.84	0.0707	18.05	0.335
11.147	0.0080	15.21	0.0833	18.38	0.394
11.61	0.0109	16.46	0.164	19.33	0.556
12.84	0.0229	17.19	0.223	19.52	0.603
13.34	0.0396	17.76	0.292	20.42	0.833

Data have also been determined for the Distribution of HCl between H₂O and each of the following compounds at 25°: Amyl Alcohol, Tertiary Amyl Alcohol, *n* Butyl Alcohol and Methyl Ethyl Ketone (Archibald, 1932.)

Results for the distribution of HCl between H₂O and Phenol are given by Wosnessensky and Astachow, 1925.

SOLUBILITY OF HYDROCHLORIC ACID GAS IN METHYL ALCOHOL, ETHYL ALCOHOL, AND IN ETHER AT 760 MM. PRESSURE.

(de Bruyn—*Rec. trav. chim.* 11, 129, '92; Schuncke—*Z. physik. Chem.* 14, 336, '94.)

t°.	Grams HCl gas per 100 Grams Solution in:		
	CH ₃ OH.	C ₂ H ₅ OH.	(C ₂ H ₅) ₂ O.
-10	54.6	...	37.51 (-9.2°)
-5	...	...	37.0
0	51.3	45.4	35.6
+5	...	44.2 (6.5°)	33.1
10	...	42.7 (11.5°)	30.35
15	...	...	27.62
20	47.0 (18°)	41.0	24.9
25	...	40.2 (23.5°)	22.18
30	43.0 (31.7°)	38.1 (32°)	19.47

FREEZING-POINTS OF MIXTURES OF ETHYL ETHER AND HYDROCHLORIC ACID.
 (Hirai, 1926.)

t°.	Mol. (C ₂ H ₅) ₂ O per 100 mols. sat. sol.	Solid Phase.	t°.	Mols. (C ₂ H ₅) ₂ O per 100 mols. sat. sol.	Solid Phase.
-117.7..	100.0	(C ₂ H ₅) ₂ O	-87.4.....	36.29	(C ₂ H ₅) ₂ O:(HCl) ₂
-118.8..	89.16	"	-87.3 m. pt..	33.33	"
-119.3..	86.93	"	-89.0.....	31.70	"
-124.2..	79.68	"	-93.5.....	27.39	"
-127.8..	77.33	"	-100.4.....	21.06	"
-126.5..	68.04	(C ₂ H ₅) ₂ O.(HCl) ₂	-104.0.....	18.76	"
-115.4..	63.66	"	-113.5.....	11.20	"
-110.9..	59.55	"	-115.5.....	10.55	"
-100.4..	52.13	"	-123.6.....	6.08	"
-100.9..	50.97	"	-123.7.....	5.70	HCl
-107.3..	47.18	"	-120.8.....	4.65	"
-94.5..	44.84	"	-120.5.....	3.87	"
-89.3..	38.24	"	-112.5.....	0.00	"

The following determinations by McIntosh, 1928, differing from the above were made in a specially constructed freezing-point apparatus provided with a magnetically operated stirrer and a very accurate platinum quartz thermometer.

Cl

t°	Mol. Percent HCl	Solid Phase	t°	Mol. Percent HCl	Solid Phase
-102.9	42.5	(C ₂ H ₅) ₂ O.HCl	-84.8	70.0	(C ₂ H ₅) ₂ O.2HCl
-100.	47.3	"	-97.6	71.6	"
-98.6	50.0	"	-99.6	80.5	(C ₂ H ₅) ₂ O.5HCl
-97.9	54.2	"	-96.2	81.5	"
-100.4	56.5	"	-92.9	83.6	"
-82.0	65.6	(C ₂ H ₅) ₂ O.2HCl	-94.2	85.0	"
-83.2	67.6	"			

 FREEZING-POINTS OF MIXTURES OF HYDROCHLORIC ACID AND ACETONE.
 (Hirai, 1926; McIntosh, 1928.)

t°	Mol. Percent HCl	Solid Phase	t°	Mol. Percent HCl	Solid Phase
-94.5	0.0	(CH ₃) ₂ CO.	-84.6	57.7	(CH ₃) ₂ CO.HCl
-107.0	14.43	(CH ₃) ₂ CO.HCl	-82.7	55.56	"
-114.6	27.29	"	-86.6	57.26	"
-91.5	36.5	"	-92.8	60.39	"
-85.7	42.99	"	-81.2	69.7	2(CH ₃) ₂ CO.5HCl
-76.9	47.1	"	-80.8	71.7	"
-78.0	54.0	"	-85.3	74.3	"
-80	52.91	"			

Data for the reciprocal solubility of HCl (also of CO₂, SO₂ and NH₃) and the vapors of Ether, Acetone, Methyl Alcohol and Chloroform, as determined by measuring at 25° the change in pressure produced by adding weighed amounts of the volatile liquid to a given volume of HCl gas, are given by MacFarlane and Wright, 1934.

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 SOLUBILITY OF DRY HYDROGEN CHLORIDE IN SEVERAL SOLVENTS
 AT 20° AND 760mm.
 (Fairbrother and Balkin, 1931.)

HYDROGEN H

Solvent	Gms. HCl per 1000cc sat. solution
Benzene (C ₆ H ₆)	16.91
Carbon Tetrachloride (CCl ₄)	6.19
Cyclo Hexane (C ₆ H ₁₂)	4.94 (17-18°)
Cyclo Hexene (<u>CH₂CH₂CH₂CH₂CH₂CH</u>)	12.29 (17-18.6°)

SOLUBILITY OF HYDROGEN CHLORIDE IN SEVERAL SOLVENTS AT 20° AND 760mm.
 (Dell, 1931.)

The solvents were saturated by bubbling HCl through them for about 3 hours, using some 8-10 times as much gas as required for saturation. The dissolved gas was determined by displacing it with a current of CO₂ free air and absorbing the HCl in H₂O and titrating it with normal NaOH.

Solvent	S	X	Solvent	S	X
Hexane	3.64	0.0197	Bromoform	4.78	0.0306
Octane	4.50	0.0296	Ethyl bromide	10.3	0.0348
Dodecane	3.42	0.0314	Chloroform	13.80	0.0444
Cetane	2.28	0.0270	Bromobenzene	7.13	0.0305
Cyclo Hexane	3.42	0.0154	Chlorobenzene	7.63	0.0315
Carbon tetrachloride	4.54	0.0181	Benzyl chloride	9.75	0.0448
Benzene	11.05	0.0425	Benzo tri chloride	4.77	0.0275
Toluene	11.90	0.0507	Tetra brom ethane	3.93	0.0236
Tetra chlor ethylene	3.88	0.0163	Tetra chlor ethane	6.20	0.0265
Tri chlor ethylene	5.79	0.0206	Ethyl bromide	35.15	0.1019
Penta chlor ethane	3.86	0.0214	Ethylene chloride	14.74	0.0457

Cl

S = the partition coefficient of HCl between the liquid and the vapor; that is $s = C$ (the gm. equiv. HCl per liter) \div 0.0417, since $s/c = 22.4 \times 293/273$; X = the mole fraction solubility calculated on the assumption that the densities of the solutions obey the ideal mixture law.

One liter sat. solution of HCl in C₆H₆ contains 3.13 gm. HCl at 20°.
 (Knight and Hinshelwood, 1927.)

One liter sat. solution of HCl in CHCl₃ contains 1.83 gm. HCl at 10°.
 (Williams, 1921.)

SOLUBILITY OF HYDROGEN CHLORIDE IN SEVERAL SOLVENTS.
 (Hamal, 1935.)

A U shaped gas buret was used for absorbing the HCl in the several solvents. From the volume change in the gas buret, the initial and final pressures and the volume of the system, the volume of HCl actually absorbed at various pressures by the liquids was calculated. The results for 20cc volumes of solvent at the observed pressures were plotted and the value for 760mm pressure was found by extrapolation. The final results were calculated to Mol. fraction of HCl absorbed at 760mm.

Solvent	Formula	b. pt. of solvent	Mol. Fraction HCl absorbed at 760mm at:		
			15°	20°	25°
Tetra Chlor Ethane	C ₂ H ₂ Cl ₄	143.5°	0.03006	0.02744	0.02481
Carbon Tetra Chloride	CCl ₄	76.0°	0.01826	0.01550	0.01277
Ethylene Chloride	C ₂ H ₄ Cl ₂	83.0°	0.04377	0.03993	0.03576
Ethylene Bromide	C ₂ H ₄ Br ₂	129.0°	0.03754	0.03441	0.03116
Tri chlor Ethane	C ₂ H ₃ Cl ₃	112.5°	0.03463	0.03101	—
Penta chlor Ethane	C ₂ HCl ₅	159.0°	0.02396	0.02250	—

Freezing-point data are given for the following mixtures:

HCl + Chloroform	(Baume and Borowski, 1914.)
" + Methyl Alcohol	" " " " ; Baume and Pamfil, 1911, 1914; Maass and McIntosh, 1913.)
" + Methyl Chloride	(Baume and Tybociner, 1914.)
" + Methyl Ether	(Maass and McIntosh, 1912; Baume, 1911, 1914.)
" + Propionic Acid	(Baume and Georgitses, 1912, 1914.)
" + Hydrogen Sulfide	" " " "
" + Magnesium Chloride	(Dernby, 1918.)
" + Sodium Chloride	" " "
" + Sulfur Chloride	(Terrey and Spong, 1932.)
" + Sulfur Dioxide	(Baume and Pamfil, 1911, 1914.)

PERCHLORIC ACID HClO_4 .

SOLUBILITY IN WATER. (van Wyk, 1902, 1905.)

Mixtures of HClO_4 and water were cooled until crystals appeared and then very gradually warmed and constantly stirred while an observation was made of the exact temperature at which the last crystal disappeared. At certain concentrations and temperatures unstable solid phases were obtained, also, curves for two series of mix crystals were encountered. The methods for detecting these phases consisted in seeding the saturated solutions with the several different crystalline forms, and observing the change in rate of cooling during the solidification of the mixture. The data for the mix-crystal curves I and II are not given in the following table:

t°.	Mols. HClO_4 per 100 Mols. $\text{HClO}_4 + \text{H}_2\text{O}$.	Solid Phase.	t°.	Mols. HClO_4 per 100 Mols. $\text{HClO}_4 + \text{H}_2\text{O}$.	Solid Phase.
0	0	Ice	-32	26	$\text{HClO}_4 \cdot 2\frac{1}{2}\text{H}_2\text{O}$
-10	5	"	-29.8	28.57	"
-21	7	"	-44	27	$\text{HClO}_4 \cdot 2\text{H}_2\text{O}$
-34.5	9	"	-41	27.25	"
-54	11	"	-34	28	"
-50.5	19	$\text{HClO}_4 \cdot 3\frac{1}{2}\text{H}_2\text{O}$	-24	29.9	"
-45	20	"	-17.8 m. pt.	33.3	"
-42.3	21	"	-21.5	36	"
-41.4	22.22	"	-23.6	36.5	" + $\text{HClO}_4 \cdot \text{H}_2\text{O}$
-43	23.5	"	-12.5	37	$\text{HClO}_4 \cdot \text{H}_2\text{O}$
-40.5	22.5	$\text{HClO}_4 \cdot 3\text{H}_2\text{O} \alpha$	+3	38	"
-39.5	22.75	"	28	40.8	"
-37.6	24	"	40	43.7	"
-37.5	26	"	50 m. pt.	50	"
-38.8	27	"	45	59.9	"
-47.8	22.5	$\text{HClO}_4 \cdot 3\text{H}_2\text{O} \beta$	27.5	71.5	"
-44	24	"	17	77.2	"
-43.5	24.5	"	+2.2	83.3	"
-43.2	25	"	-21.5	90.7	"
-44.5	26	"	-40	94	"
-37.2	25	$\text{HClO}_4 \cdot 3\text{H}_2\text{O} \alpha + \text{HClO}_4 \cdot 2\frac{1}{2}\text{H}_2\text{O}$	-102	100	"

HYDROGEN FLUORIDE HF

FREEZING-POINTS OF MIXTURES OF HYDROGEN FLUORIDE AND WATER.
(Cady and Hildebrand, 1930.)

The mixtures were contained in a gold cup provided with a gold plated stirrer. The temperatures were measured with a thermo couple encased in a platinum tube. To about 100cc of solution in the gold cup enough liquid air was added to partially freeze the solution. After stirring for 15 minutes the temperature was read and immediately afterwards a sample was removed for analysis. This was weighed in a paraffine lined bottle, diluted with water and titrated with NaOH using phenolphthaleine as indicator. In some cases it was necessary to determine warming curves and take the final sudden change in slope as the freezing-point. The authors give the observed freezing-points as °K but in the following table they have been converted to the ordinary scale by deducting each one from -273°.

t°	Gm. Mols. HF per 100 gm. Mols. HF + H ₂ O	Solid Phase	t°	Gm. Mols. HF per 100 gm. Mols. HF + H ₂ O	Solid Phase
-0.9	0.777	Ice	-75.4	69.8	2HF.H ₂ O
-6.3	5.64	"	-75.7	71.0	"
-9.8	8.09	"	-81.7	74.3	"
-23.0	15.65	"	-91.1	76.2	"
-41.4	21.6	"	-101.3	77.6	" + 4HF.H ₂ O
-60.0	26.5	"	-100.7	78.6	4HF.H ₂ O
-70.1	27.6	" + HF.H ₂ O	-100.3	79.6	"
-62.7	30.7	HF.H ₂ O	-100.2	80.0	"
-59.4	32.1	"	-100.6	81.7	"
-48.9	37.1	"	-105.4	86.4	"
-43.5	40.3	"	-110.8	88.3	" + HF
-36.1	47.8	"	-106.9	89.4	HF
-35.3	50.0	"	-99.7	91.3	"
-35.8	51.5	"	-93.6	93.9	"
-41.5	57.5	"	-88.9	96.1	"
-51.0	62.7	"	-86.9	97.4	"
-68.3	67.5	"	-85.4	98.2	"
-75.1	68.5	" + 2HF.H ₂ O	-82.9	100.0	"

SOLUBILITY OF HYDROGEN FLUORIDE IN BENZENE.

(Simons, 1931.)

Vessels made entirely of copper were used. The vapor of HF at its b. pt. or that carried over by nitrogen from liquid HF maintained at other temperatures, was conducted into benzene until the saturation point was reached at selected temperatures. These results were plotted and the following values obtained from the curves.

t° of the Liquid HF from which its vapor was conducted	Gm. Mols. HF dissolved per 100 gm. mols. HF + C ₆ H ₆ at:				
	20°	30°	40°	50°	60°
-77	2.48	2.03	1.58	1.12	0.71
-18	3.85	3.15	2.44	1.73	1.02
0	4.32	3.55	2.75	1.96	1.17
b. pt.	6.73	5.48	4.22	2.98	1.80

Vapor pressure results are also given.

Similar determinations of the solubility of HF vapor at its b. pt. in octane, gave the following results.

t° of sat. sol. in Octane	25.1°	36.0°	45.2°	51.0°	66.3°
Mols. HF per 100 mols. HF + C ₈ H ₁₈	0.338	0.276	0.235	0.194	0.170

Freezing-point data for mixtures of HF + KF are given by Cady, 1934, and the mixtures of HF + NH₃ by Ruff and Staub, 1933.

HYDRIODIC ACID HI.

SOLUBILITY IN WATER, DETERMINED BY FREEZING-POINT METHOD.
(Pickering, 1893a.)

(Fleming, 1933)						
t°.	Gm. HI per 100 Gms. Sat. Sol.	Solid Phase.	t°.	Gms. HI per 100 Gms. Sat. Sol.	Solid Phase.	
-10	20.3	Ice	-60	52.6	HI ₄ H ₂ O	
-20	29.3	"	-40	59	"	
-30	35.1	"	about -35.5 m. pt.		64	"
-40	39	"	-40	65.5	"	
-50	42	"	-49	66.3	" + HI ₃ H ₂ O	
-60	44.4	"	-48 m. pt.	70.3	HI ₃ H ₂ O	
-70	46.2	"	-56	73.5	" + HI ₂ H ₂ O	
-80	47.9	" + HI ₄ H ₂ O	-52	74	HI ₂ H ₂ O	

F.-pt. data for HI + H₂S (Bagster, 1911), HI + (CH₃)₂O. (Maass and McIntosh, 1912)

HYDROGEN IODIDE

EQUILIBRIUM IN THE SYSTEMS HYDROGEN IODIDE, WATER AND ALCOHOLS.
(Reburn and Shearer, 1933.)

The determinations were made by adding from a buret one of the constituents to known mixtures of the other two, until appearance of a permanent turbidity. The tie lines of the saturation curves thus obtained were determined by mixing suitable amounts of the three constituents to yield two liquid layers and titrating each of these for acid content.

Results for HI + H₂O + Iso Amyl Alcohol ((CH₃)₂CHCH₂CH₂OH) Results for HI + H₂O + Iso Butyl Alcohol ((CH₃)₂CHCH₂OH)

Gms. per 100 gms. sat. sol.		Gms. per 100 gms. sat. sol.		Gms. per 100 gms. sat. sol.	
H ₂ O	C ₅ H ₁₂ O	H ₂ O	C ₅ H ₁₂ O	H ₂ O	C ₄ H ₁₀ O
8.50	91.5	43.2	15.7	16.1	88.9
12.0	82.8	62.3	2.76	24.9	67.0
21.0	58.8	76.6	2.55	32.0	54.7
24.0	52.6	77.5	3.03	37.8	46.7
25.8	47.5	91.2	2.98	39.6	44.3
27.8	43.2	97.2	2.80	61.9	19.3
29.1	40.1			91.2	8.81

Tie Line Data

Tie Line Data

Gms. HI per 100 gms.:		Gms. HI per 100 gms.:	
H ₂ O layer	C ₅ H ₁₂ O layer	H ₂ O layer	C ₄ H ₁₀ O layer
16.84	9.45	11.6	8.3
30.0	21.1	4.8	4.0
41.1	30.5		

FREEZING-POINTS OF DILUTE AQUEOUS SOLUTIONS OF HYDROGEN IODIDE.
(Klein and Svanberg, 1920.)

t° of F. pt.	Normality of HI
-0.35	0.1
-0.91	0.25
-1.90	0.50

HYDROGEN IODATE HIO_3

SOLUBILITY OF IODIC ACID IN WATER. (Groschuff, 1906.)					
t°.	Gms. I_2O_5 per 100 Gms. Sat. Sol.	Solid Phase.	t°.	Gms. I_2O_5 per 100 Gms. Sat. Sol.	Solid Phase.
- 0.3	1.69	Ice	16	71.7	HIO_3
- 1.01	6.81	"	40	73.7	"
- 2.38	26.22	"	60	75.9	"
- 4.72	51.42	"	80	78.3	"
- 6.32	57.61	"	85	78.7	"
-12.25	67.40	"	101	80.8	"
-14	69.10	" + HIO_3	110	82.1	$\text{HIO}_3 + \text{HI}_3\text{O}_8$
-15	70	(unstable) Ice	125	82.7	HI_3O_8
-19	72	" "	140	83.8	"
0	70.3	HIO_3	160	85.9	"

IO

SOLUBILITY OF IODIC ACID IN NITRIC ACID. (Groschuff.)
Gms. HIO_3 per 100 Gms.

t°.	Aq. Solution.	27.73% HNO_3 Solution.	40.88% HNO_3 Solution.
0	74.1	18	9
20	75.8	21	10
40	77.7	27	14
60	80	38	18

SOLUBILITY OF HYDROGEN IODATE IN AQUEOUS SOLUTIONS OF
NITRIC ACID AT 25°.

(Moles and Perez-Vitoria, 1931, 1932.)

Wt. Percent HNO_3	d of the $\text{HNO}_3 + \text{H}_2\text{O}$ mixture	Gms. HIO_3 per 100 gms. sat. sol.	Wt. Percent HNO_3	d of the $\text{HNO}_3 + \text{H}_2\text{O}$ mixture	Gms. HIO_3 per 100 gms. sat. sol.
20.23	1.123	35.09	50.71	1.324	5.74
28.00	1.173	21.84	58.66	1.366	3.25
35.28	1.223	15.20	65.30	1.400	1.40
43.32	1.273	10.08			

H HYDROGEN

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HYDROGEN NITRATE (Nitric Acid) HNO_3

RECIPROCAL SOLUBILITY OF NITRIC ACID AND WATER, DETERMINED BY THE FREEZING-POINT METHOD.

(Küster and Kremann, 1904; see also Pickering, 1893.)

t°.	Gms. HNO_3 per 100 Gms. Sat. Sol.	Solid Phase.	t°.	Gms. HNO_3 per 100 Gms. Sat. Sol.	Solid Phase.
-10	13.9	Ice	-40	69.7	$\text{HNO}_3 \cdot 3\text{H}_2\text{O}$
-20	22.9	"	-42 Eutec.	70.5	" + $\text{HNO}_3 \cdot \text{H}_2\text{O}$
-30	27.8	"	-40	72.5	$\text{HNO}_3 \cdot \text{H}_2\text{O}$
-40	31.5	"	-38 m. pt.	77.75	"
-43 Eutec.	32.7	" + $\text{HNO}_3 \cdot 3\text{H}_2\text{O}$	-40	82.4	"
-40	34.1	$\text{HNO}_3 \cdot 3\text{H}_2\text{O}$	-50	86.5	"
-30	40	"	-60	88.8	"
-20	49.2	"	-66.3 Eutec.	89.95	" + HNO_3
-18.5 m. pt.	53.8	"	-60	91.9	HNO_3
-20	58.5	"	-50	94.8	"
-30	65.4	"	-41.2 m. pt.	100	"

NITRIC ACID.

FREEZING-POINTS OF AQUEOUS NITRIC ACID SOLUTIONS.

(Klein and Svanberg, 1920.)

t° of f. pt.	Normality of aq. HNO_3 .	t° of f. pt.	Normality of aq. HNO_3 .	t° of f. pt.	Normality of aq. HNO_3 .
-0.356.....	0.10	-0.885.....	0.25	-1.797.....	0.50

RECIPROCAL SOLUBILITY OF NITRIC ACID AND NITROGEN PEROXIDE (N_2O_4).

(Pascal and Garnier, 1919.)

Thermic analysis was used for determination of the solubility at very low temperatures and for the detection of the internal transformations in the system.

Solubility, in the Liquid State, of :

N_2O_4 in HNO_3 .

HNO_3 in N_2O_4 .

t°.	Gms. HNO_3 per 100 gms. mixture.	Solid Phase.	t°.	Gms. HNO_3 per 100 gms. mixture.	t°.	Gms. HNO_3 per 100 gms. mixture.
-42.....	100.0	HNO_3	-11.....	52.0	-13.25.....	2.75
-58.5.....	90.6	"	-0.8.....	50	-5.0.....	4.20
-70.....	85	"	+15.....	45	+5.0.....	5.20
-73 (Eutec.)..	82	" + N_2O_4 (Solid)	20.....	44.3	19.5.....	7.15
-58.5.....	70	N_2O_4 (solid)	35.....	37.5	40.0.....	10.0
-48.5.....	66	"	50.....	30	55.0.....	20.0
-32.....	62	"				
-21.4.....	60	"				

Determinations of the compositions of the two liquid layers which are formed in the system nitric acid and nitrogen peroxide at certain temperatures, were made by Bousfield, 1919, by means of density measurements, and the following results were obtained.

N_2O_4 in HNO_3 .

HNO_3 in N_2O_5 .

t°.	Density of mixture.	Specific volume.	Per cent HNO_3 .	t°.	Density of mixture.	Specific volume.	Per cent HNO_3 .
4.0...	1.65432	0.60448	45.6	4.0...	1.48742	0.67231	4.90
11.0...	1.63942	0.60997	45.7	11.0...	1.47351	0.67865	6.67
18.0...	1.62501	0.61538	46.0	18.0...	1.45940	0.68521	8.05

Freezing-points of mixtures of $\text{HNO}_3 + \text{H}_2\text{SO}_4 + \text{H}_2\text{O}$ over a wide range of composition, especially for the region of high concentration of H_2SO_4 , have been determined by Holmes, 1920, Carpenter and Lehrman, 1925 and Holmes, Hutchinson and Zieber, 1931. These latter investigators give a triangular diagram constructed from all available data on this system, showing the iso thermal freezing curves for mixtures of varying percentage composition.

NITRIC ACID HNO_3 .

DISTRIBUTION OF NITRIC ACID BETWEEN WATER AND ETHER AT 25°. (Bogdan, 1905, 1906.)

Mols. HNO_3 per Liter of:		Mols. HNO_3 per Liter of:	
H_2O Layer.	Ether Layer.	H_2O Layer.	Ether Layer.
0.9145	0.0855	0.09005	0.00181
0.4811	0.0278	0.04749	0.00064
0.2644	0.00894	0.02760	0.00029
0.1392	0.00278	0.02462	0.00025

NO

Data for the distribution of HNO_3 between Water and each of the following compounds; Ether, *n* Butyl Alcohol, *n* Amyl Alcohol and Methyl Ethyl Ketone are given by Archibald, 1932.

HYDROGEN OXIDE (Water) H_2O

Note - Data for the Reciprocal Solubility of Water in Organic Solvents, in addition to those here shown, will be found in Volume 2., under the respective Organic Compounds.

O

RECIPROCAL SOLUBILITY OF WATER AND SEVERAL ORGANIC COMPOUNDS AT 20°. (Evans, 1936.)

The author describes an improvement of the Hill, 1923, method of determining the mutual solubility of liquids, which consists in the more suitable choice of the volume ratios of the two liquids. He also describes a simplified form of apparatus to be used.

The following results were obtained with the improved technique.

Organic Solvent	Solvent, Water		Solvent, Organic Compound	
	$d \frac{20}{4}$ of sat. sol.	Gms. Org. Solvent per 100 gms. sat. sol. in H_2O	$d \frac{20}{4}$ of sat. sol.	Gms. H_2O per 100 gms. sat. sol. in Org. Solvent
Sec. Butyl Alcohol	0.971	18.5	0.880	64.4
Methyl Ethyl Ketone	0.962	26.7	0.836	87.9
Methyl tert. Butyl Ether	0.990	4.8	0.745	98.5
Methyl tert. Amyl Ether	0.995	1.25	0.771	99.3
Chloroform	1.001	0.8	1.486	99.8

SOLUBILITY OF WATER IN SEVERAL ORGANIC SOLVENTS. (Clifford, 1921.)

The saturated solutions were analyzed by volatilizing the sample and absorbing the moisture in a dehydrating agent (CaCl_2) which does not absorb or react with the organic solvent.

Solvent.	t°.	Gms. H_2O per 100 gms. sat. sol.	Solvent.	t°.	Gms. H_2O per 100 gms. sat. sol.
Benzene	21.0	0.046	Carbon disulfide.....	25.0	0.010
»	26.6	0.056	»	26.0	0.011
»	42.0	0.088	»	27.0	0.012
»	55.0	0.113	Carbon tetrachloride.	24.0	0.010
Chloroform	24.5	0.084	»	28.5	0.013
»	26.7	0.107	Gasoline	25.0	0.0085-0.0100
»	27.8	0.116	»	35.0	0.0121-0.0161
			»	37.5	0.0145-0.0175

Results for the Solubility of H_2O , Blood and Oils in cyclo Propane ($\text{CH}_2=\text{CH}_2\cdot\text{CH}_2$) are given by Orcutt and Seevers, 1937.

SOLUBILITY OF WATER IN BENZENE, TOLUENE AND CARBON TETRACHLORIDE.
(Rosenbaum and Walton, 1930.)

The H_2O dissolved in the organic solvents was determined by converting it to H_2 with the aid of calcium hydride according to the reaction $2\text{H}_2\text{O} + \text{CaH}_2 = \text{Ca(OH)}_2 + 2\text{H}_2$. Very high accuracy is claimed for the method, but it cannot be employed with solvents which react with CaH_2 and the determinations require considerable time for completion of the reaction.

t°	Gms. H_2O dissolved per 100 gms.		
	C_6H_6	$\text{C}_6\text{H}_5\text{CH}_3$	CCl_4
10	0.0451	0.0335	0.00711
20	0.0573	0.0450	0.00844
30	0.0746	0.0600	0.0109
40	0.0953	0.0733	0.0152
50	0.1271	0.0953	0.0237
60	0.1637	—	—

The presence of CS_2 in CCl_4 as an impurity was found to increase the solubility of water in this solvent about 50 percent.

SOLUBILITY OF WATER IN BENZENE, TOLUENE AND CYCLO HEXANE.
(Tarassenkow and Poloshinzewa, 1931, 1932.)

The determinations were made by the synthetic method of Alexieff as improved by Rothmund.

Results for C_6H_6		Results for $\text{C}_6\text{H}_5\text{CH}_3$		Results for C_6H_{12}	
t°	Gms. H_2O per 100 gms. sat. sol.	t°	Gms. H_2O per 100 gms. sat. sol.	t°	Gms. H_2O per 100 gms. sat. sol.
5.0	0.024	-9.0	0.002	14.0	0.005
9.5	0.034	-3.5	0.005	19.0	0.010
14.5	0.041	+10.5	0.020	28.5	0.015
22.5	0.060	18.0	0.034	32.5	0.020
32.0	0.082	30.0	0.053	38.0	0.031
40.	0.102	48.0	0.097	53.0	0.050
56	0.181	60.5	0.153		
67.5	0.251	76.0	0.254		
73.0	0.300	93.0	0.413		

SOLUBILITY OF WATER IN BENZENE. (Hill, 1923.)

A new thermostatic method was employed. This is based upon the unusual solubility relations of silver perchlorate. This compound is soluble in various organic solvents and exceptionally soluble in water. Consequently, the presence of small amount of water in an organic solvent greatly increases the solubility of silver perchlorate in that solvent. The method consists in making a reference curve for the solubility of silver perchlorate in the organic solvent containing known amounts of water. Saturated solutions of water in the organic solvent are then made at various temperatures and each of these used as solvent for silver perchlorate at the temperature of the reference curve. By comparison with the reference curve the percentage of water in the solvent becomes known. The data for the reference curve of silver perchlorate in benzene + water mixtures at 25° will be found under silver perchlorate at the bottom of page 1401. The estimated results for the solubility of water in benzene are as follows.

t°.	Gms. H ₂ O per 100 gms. sat. solution.	t°.	Gms. H ₂ O per 100 gms. sat. solution.	t°.	Gms. H ₂ O per 100 gms. sat. solution.
3.0.....	0.035	37.5.....	0.109	65.0.....	0.232
5.4.....	0.037	40.0.....	0.118	66.0.....	0.238
15.0.....	0.051	50.0.....	0.158	69.5.....	0.258
23.0.....	0.063	55.0.....	0.181	77.0.....	0.304
25.0.....	0.072	57.5.....	0.193		

Data for the effect of H₂O upon the Critical Solution Temperatures of mixtures of CH₃OH + CS₂, CH₃OH + n Hexane and CH₃OH + Cyclo Hexane are given by de Brouckere and Gillet, 1935. The authors used the results as the basis of a method for the determination of H₂O.

SOLUBILITY OF WATER IN BENZENE SOLUTIONS OF MONO, DI, AND TRI CHLOR ACETIC ACIDS AT 15°

(Bell, 1930.)

Results for solutions in C₆H₆ of:

CH ₂ ClCOOH			CHCl ₂ COOH			CCl ₃ COOH		
d of sat. sol.	Gm. Mols. per 1000 gms. sat. sol.		d of sat. sol.	Gm. Mols. per 1000 gms. sat. sol.		d of sat. sol.	Gm. Mols. per 1000 gms. sat. sol.	
	CH ₂ ClCOOH	H ₂ O		CHCl ₂ COOH	H ₂ O		CH ₂ ClCOOH	H ₂ O
0.884	0.0620	0.0329	0.880	0.035	0.0408	0.878	0.0278	0.0426
0.881	0.115	0.0423	0.880	0.071	0.055	0.878	0.0506	0.0690
0.880	0.174	0.0574	0.883	0.123	0.101	0.887	0.0950	0.115
0.885	0.217	0.0645	0.895	0.179	0.130	0.885	0.140	0.165
0.888	0.284	0.0776	0.890	0.195	0.138	0.888	0.176	0.210
0.886	0.325	0.0828				0.892	0.219	0.247
0.892	0.404	0.1000						

The author recalculated the results of Waddell, 1898, for benzene solutions of acetic acid at 25° and obtained the following values.

d of sat. sol.	Gm. Mols. per 1000 gms. sat. sol.	
	CH ₃ COOH	H ₂ O
0.874	0.077	0.011
0.876	0.215	0.033

SOLUBILITY OF WATER IN BENZENE, TOLUENE AND XYLENE
SOLUTIONS OF ETHANOLAMINE OLEATE (SOAP)
(Pink, 1938.)

Gm. Mols. Ethanolamine Oleate per liter organic solvent	cc H ₂ O dissolved per 50cc of Ethanolamine Solution in		
	Benzene (C ₆ H ₆)	Toluene (C ₆ H ₅ CH ₃)	Xylene C ₆ H ₄ (CH ₃) ₂
0.05	0.18	0.17	0.18
0.10	0.38	0.34	0.36
0.20	0.70	0.68	0.69
0.30	1.06	1.05	1.08
0.40	1.40	1.32	1.36
0.50	1.70	1.68	1.68
0.60	2.08	2.03	2.07
0.70	2.35	2.34	2.36

The determinations were made by adding the water from a microburet to the mixtures until on active shaking a faint cloudiness appeared. The temperature is not stated but was probably that of the room. The quantity of water dissolved is proportional to the quantity of the Ethanolamine oleate (soap) present. It was also found that additions of small quantities of phenol greatly increased the amount of water dissolved. Further quantities of phenol however caused the solutions to become cloudy again.

SOLUBILITY OF WATER IN BENZENE, PETROLEUM AND PARAFFINE OIL.
(Groschuff, 1911.)

The synthetic, sealed tube method was used and the experiments were made with very great care. The mixtures were first superheated sufficiently to bring all the water into solution and then cooled until a fine mist was formed. The temperature of appearance and disappearance of this fine mist was determined repeatedly. The benzene was of $d_{20} = 0.8799$. The petroleum was American water white, of $d = 0.792$. It was freed from H₂O by distilling 3 times from melted Na and boiled at 190–250° at atmospheric pressure. The paraffine oil was first heated to 120–130° and then distilled twice under vacuum over melted Na and once without Na. Its $d_{18} = 0.883$ and b.-pt. was 200°–300° at 10 mm. pressure.

Results for:

H ₂ O + Benzene.		H ₂ O + Petroleum.		H ₂ O + Paraffine Oil.	
t°.	Gms. H ₂ O per 100 Gms. Sol.	t°.	Gms. H ₂ O per 100 Gms. Sol.	t°.	Gms. H ₂ O per 100 Gms. Sol.
+ 3	0.030	— 2	0.0012	59	0.031
23	0.061	+18	0.005	61	0.035
40	0.114	23	0.007	66	0.043
55	0.184	30	0.008	79	0.063
66	0.255	36	0.012	85	0.075
77	0.337	53	0.026	94	0.097
				+16	0.003
				50	0.013
				65	0.022
				73	0.030
				77	0.035
				94	0.055

Observations on the solubility of water in essential oils are given by Umney and Bunker (1912).

HYDROGEN OXIDE (Water)

SOLUBILITY OF WATER IN AVIATION GASOLINES.

(Aldrich, 1931.)

The samples of gasoline were saturated with H_2O by shaking the mixture in an evacuated bulb, provided with all the refinements for accurate removal of the saturated sample for analysis. The H_2O in this sample was determined by adding sodium-potassium alloy, free of oxide, and collecting and measuring the evolved hydrogen. The determinations were made with the greatest possible accuracy.

t°	Gm. H_2O per 100 gms. sat. solution in Gasoline No.:				
	10	12	13	15	19
10	0.0128	0.0051	0.0071	0.0055	0.0036
30	0.0160	0.0067	0.0086	0.0172	0.0052
50	0.0193	0.0079	0.0101	0.0208	0.0069

Gasoline sample No. 10 = Oklahoma natural gasoline, $d_{15} = 0.677$.

" " No. 12 = West Virginia natural gasoline, $d_{15} = 0.695$.

" " No. 13 = California Crude, $d_{15} = 0.695$.

" " No. 15 = Midcontinental crude, $d_{15} = 0.718$.

" " No. 19 = Oklahoma natural gasoline, $d_{15} = 0.682$.

Except for fuel No. 15 the change in solubility with temperature is represented by a straight line

Using the calcium chloride method, Clifford, 1921, obtained the following values for the solubility of H_2O in gasoline of $d = 0.700$

t°	Gms. H_2O per 100 gms. sat. solution
25	0.0085; 0.0110
35	0.0161; 0.0121
37.5	0.0175; 0.0145

The Army Air Corps, 1922, using the calcium chloride method found the solubility of water in domestic aviation gasoline at 23.9° to be 0.007 gm. H_2O per 100 gms. sat. solution.

Using the same method Uspenskii, 1929 obtained the following results:

Gasoline	Gm. H_2O per 100 gms. sat. sol. at:	
	100	220
Grozny "avis"	0.007	0.011
" grade I	0.006	0.008
" grade II	0.006	0.008
Baku grade II	0.005	0.008

WATER TOLERANCE OF MIXTURES OF GASOLINE WITH ETHYL ALCOHOL
ISO PROPYL ALCOHOL AND BENZENE.
(Sayley and Hopkins, 1934.)

The mixtures contained in a test tube provided with a thermometer and a stirrer were cooled in a Dewar flask containing acetone and CO_2 snow until the cloud point was reached. The tube was then removed and the point at which the cloud just disappeared with rising temperature, was taken as the critical solution temperature. Three samples of gasoline, two of Iso propyl Alcohol and a series of samples of Ethyl Alcohol containing from 1.63 to 5.65 Volume percent H_2O were used. Numerous diagrams showing the observed c.s.t. of various mixtures of the gasolines, alcohols and water are given. From these, various tables are constructed which show the relation of H_2O content to c.s.t. in mixtures of varying composition. Thus, for example, the critical Water Content of Mixtures containing 90, 80 and 70 percent of regular grade automobile fuel (liquid phase cracked gasoline) is as follows.

Vol. Percent Composition of Mixture			Critical H_2O Content in Vol. % at:		
Gasoline	Ethyl Alcohol	Iso propyl Alcohol	0°	-20°	-40°
90	10	0	0.30	0.22	0.15
90	8	2	0.35	0.27	0.19
90	7	3	0.38	0.30	0.22
90	6	4	0.41	0.33	0.25
80	20	0	0.70	0.50	0.35
80	16	4	—	0.64	0.46
80	12	8	—	0.80	0.60
70	30	0	1.25	0.84	0.59
70	25	5	—	1.09	0.76
70	20	10	—	1.25	1.00

Iso propyl Alcohol increases the water tolerance and the critical water content of any ethyl alcohol-gasoline mixture to which it is added. Benzene may be used to increase moderately the critical water content of ethyl alcohol-gasoline mixtures by substituting benzene for part of the gasoline. Its effect, however, in increasing water tolerance appears to be too slight to be of practical value.

HYDROGEN PEROXIDE H_2O_2 .

FREEZING-POINTS OF MIXTURES OF HYDROGEN PEROXIDE AND WATER.
(Maass and Herzberg, 1920.)

t° of f. pt.	Gms H_2O_2 per 100 gms. mixture.	Solid Phase.	t° of f. pt.	Gms H_2O_2 per 100 gms. mixture.	Solid Phase.
-2.0...	100	H_2O_2	-51.7...	49.8	$\text{H}_2\text{O}_2 \cdot 2 \text{H}_2\text{O}$
-14.0...	86.0	"	-50.8...	47.0	"
-22.7...	80.45	"	-51.8...	46.21	"
-36.5...	74.0	"	-46.25...	42.02	H_2O
-39.5...	69.2	"	-38.0...	37.80	"
-45.5...	65.4	"	-35.7...	36.47	"
-50.0...	63.05	"	-28.5...	31.96	"
-52.5...	61.14	"	-23.4...	27.72	"
-54.5...	58.8	$\text{H}_2\text{O}_2 \cdot 2 \text{H}_2\text{O}$	-17.0...	22.50	"
-54.3...	56.2	"	-11.1...	15.91	"
-53.6...	55.06	"	-6.3...	9.96	"
-52.5...	53.7	"	-3.4...	4.9	"

HYDROGEN PEROXIDE H_2O_2 .

EQUILIBRIUM IN THE SYSTEM HYDROGEN PEROXIDE, UREA AND WATER.
(Jänecke, 1932.)

To aqueous hydrogen peroxide solutions of known concentrations weighed amounts of urea were added and the mixtures warmed until clear. Upon cooling the temperature was determined at which crystals separated. The Solid Phases were ice, urea or the double compound $CO(NH_2)_2 \cdot H_2O_2$.

Wt. % H_2O_2 in Aqueous Solvent	Temp. of Saturation of Solution containing:					
	10 Wt. % $CO(NH_2)_2$	20 Wt. % $CO(NH_2)_2$	30 Wt. % $CO(NH_2)_2$	40 Wt. % $CO(NH_2)_2$	50 Wt. % $CO(NH_2)_2$	60 Wt. % $CO(NH_2)_2$
3.0	-5.0	-6.5	-9.7	-0.8	+16.5	+35.0
6.0	-6.0	-7.5	-2.0	+6.0	+12.2	+20.3
10.0	-8.0	-2.0	+3.3	+5.5	+14.0	+34.5
15.0	-3.0	+6.0	+11.6	+13.5	+15.2	+32.0
20.0	+2.7	+12.2	+19.2	+21.0	+22.5	+31.5
30.0	+7.0	+20.3	+27.5	+32.0	+34.5	+34.4

Wt % H_2O_2 in Aqueous Solvent	Temp. of Saturation of Solution containing:						
	5 Wt. % $CO(NH_2)_2$	10 Wt. % $CO(NH_2)_2$	15 Wt. % $CO(NH_2)_2$	20 Wt. % $CO(NH_2)_2$	25 Wt. % $CO(NH_2)_2$	33.7 Wt. % $CO(NH_2)_2$	43.7 Wt. % $CO(NH_2)_2$
36.0	-1.0	+12.0	+20.0	+25.0	+30.5	+36.0	+40.5
47.7	0.0	+15.0	+25.0	+31.0	+38.0	—	—
59.9	+2.0	+11.0	+22.5	+33.0	—	—	—
79.1	-8.0	+12.5	+26.0	+35.5	+47.5	—	—
91.8	-20.0	+4.0	+20.0	+31.5	+45.0	—	—

FREEZING-POINTS OF MIXTURES OF HYDROGEN PEROXIDE AND METHYL ALCOHOL.
(Matheson and Maass, 1929.)

t°	Gm. Mol. CH_3OH per 100 gm. mols. $CH_3OH + H_2O_2$	Solid Phase	t°	Gm. Mol. CH_3OH per 100 gm. mols. $CH_3OH + H_2O_2$	Solid Phase
-1.7	5.6	H_2O_2	-18.6	28.3	H_2O_2
-6.4	13.2	"	-22.2	33.2	"
-10.2	18.4	"	-37.8	43.8	"
-15.3	25.2	"	-49.3	51.5	"

The authors also give results for the freezing-points of mixtures of hydrogen peroxide and each of the following compounds: Ethyl Ether, Piperidine, Di ethyl amine, Mono n Butylamine, Tertiary mono Butylamine, Di iso Butylamine, Tripropylamine and Di methyl amine.

DISTRIBUTION OF HYDROGEN PEROXIDE BETWEEN WATER AND ETHYL ETHER
AT 18°. (de Kolossovsky, 1919, 1925.)

The mixtures of equal volumes of water and ether, to which different amounts of redistilled « Perhydrol » were added, were vigorously shaken during 20 minutes, by periods of 2 minutes each, and allowed to stand in the thermostat between the agitations and for 1 hour after the last. Aliquot portions of each layer were titrated with aqueous KMnO_4 solution in presence of sulfuric acid. The determinations were plotted and the following results were obtained from the curve.

Gms. H_2O_2 per 100 cc.		$\frac{p_1}{p_2}$	Gms. H_2O_2 per 100 cc.		$\frac{p_1}{p_2}$
H_2O layer (p_1).	$(\text{C}_2\text{H}_5)_2\text{O}$ layer (p_2).		H_2O layer (p_1).	$(\text{C}_2\text{H}_5)_2\text{O}$ layer (p_2).	
0.935	0.065	14.4	17.908	2.092	8.6
2.795	0.205	13.6	19.590	2.410	8.1
4.640	0.360	12.9	21.251	2.749	7.7
6.470	0.530	12.2	23.707	3.293	7.2
9.182	0.818	11.2	25.324	3.676	6.9
10.968	1.034	10.6	26.929	4.071	6.6
12.734	1.266	10.1	28.522	4.478	6.4
14.479	1.521	9.5	30.119	4.881	6.2
16.204	1.796	9.0	31.714	5.286	6.0

0

DISTRIBUTION OF HYDROGEN PEROXIDE BETWEEN WATER AND ORGANIC SOLVENTS.
(Walton and Lewis, 1916.)

Different amounts of perhydrol (30% H_2O_2 solution) were added to various mixtures of water and organic solvents and, after constant agitation for about 1 hour, the H_2O_2 in each layer was determined.

Solvent	t°	Ratio, Conc. aq.	Solvent.	t°	Ratio, Conc. aq.
		Conc. org. solvent			Conc. org. solvent
Ethyl Acetate	25	3.92- 4.11	Methyl Iodide	25	Approx. 200
Isobutyl Alcohol	25	2.58- 2.63	m Toluidine	25	Approx. 5
Amyl Acetate	25	13 -13.2	Phenol	25	4.35 -5.55
Acetophenone	25	5.82- 6.06	Quinoline	0	0.276-0.391
Ether	25	8.28- 9.11	"	25	0.365-0.642
Ether	0	5.72- 5.85	"	40	0.516-0.602
Aniline	25	4.08- 4.10			

The following approximate values, determined at room temp., are quoted from the dissertation of A. Braun, Univ., Wisconsin, 1914.

Solvent.	Ratio, Conc. aq.	Solvent.	Ratio, Conc. aq.	Solvent.	Ratio, Conc. aq.
	Conc. org. solvent		Conc. org. solvent		Conc. org. solvent
Ethyl Acetate	$\frac{2}{3}$	Ethylisovalerianate	$\frac{1}{30}$	Isobutyl Alcohol	$\frac{1}{3}$
Nitrobenzene	$\frac{1}{100}$	Isoamyl Propionate	$\frac{1}{12}$	Propyl Formate	$\frac{1}{3}$
Acetophenone	$\frac{1}{2}$	Chloroform	$\frac{1}{100}$	Isobutyl Butyrate	$\frac{1}{30}$
Amyl Acetate	$\frac{1}{3}$	Benzene	$\frac{1}{100}$	Propyl Butyrate	$\frac{1}{30}$

The distribution ratio of hydrogen peroxide between water and ether at 17.5° varies with concentration from 13.9 to 17.4.
(Osipoff and Popoff, 1903.)

DISTRIBUTION OF HYDROGEN PEROXIDE BETWEEN WATER AND AMYL ALCOHOL
AT 0° AND AT 25°.
(Calvert, 1901; Joyner, 1912.)

Results at 0°. (Calvert, Joyner.)

Mols. H ₂ O ₂ per Liter.		$\frac{W}{A}$
H ₂ O layer (W).	Alcohol Layer (A).	
0.146	0.0216	6.76
0.200	0.030	6.66
0.407	0.061	6.63
0.749	0.113	6.66
1.970	0.293	6.71

Results at 25°. (Calvert.)

Mols. H ₂ O ₂ per Liter.		$\frac{W}{A}$
H ₂ O Layer (W).	Alcohol Layer (A).	
0.094	0.013	7.01
0.194	0.028	6.91
0.297	0.042	7.08
0.670	0.095	7.09
0.913	0.130	7.01

Data are also given for the distribution of hydrogen peroxide between aqueous sodium hydroxide solutions and amyl alcohol at 0° and at 25°.

The following results for the distribution of hydrogen peroxide between water and Iso amyl alcohol (b.pt. 128°-130°) at 0° are given by Husain, 1927, but the terms in which the concentrations are expressed are not stated.

Conc. of H ₂ O ₂ in H ₂ O (W)	Conc. of H ₂ O ₂ in Alcohol (A)	$\frac{W}{A}$
26.90	4.10	6.56
32.12	4.93	6.53

This author also gives results for the distribution of H₂O between Iso Amyl alcohol and aqueous solutions of sodium and potassium phosphates at 0°.

DISTRIBUTION OF HYDROGEN PEROXIDE BETWEEN WATER AND AMYL ALCOHOL
AT 0°. (Menzel, 1923.)

Cc. 0.05 N Thiosulfate solution

required for 10 cc. of		$\frac{W}{A}$
Aq. layer (W.).	Alcoholic layer (A).	
32.05	4.60	6.97
36.50	5.27	6.96
43.83	6.36	6.89
46.50	6.70	6.94
52.85	7.73	6.85

Cc. 0.05 N Thiosulfate solution

required for 10 cc. of		$\frac{W}{A}$
Aq. layer (W).	Alcoholic layer (A)	
52.95	7.70	6.88
59.15	8.60	6.88
68.00	10.05	6.80
76.25	11.23	6.79

Data are also given for the distribution of hydrogen peroxide between aqueous solutions of potassium metaborate and tetraborate, and amyl alcohol at 0°.

Freezing-point Data have been determined for Mixtures of :

H ₂ O ₂ + KCl	(Matheson and Maass, 1929.)
" + K ₂ SO ₄	" " " "
" + NaF	" " " "
" + H ₂ SO ₄	" " " "
" + NH ₄ Cl	(Maass and Hatcher, 1922.)
" + NaCl	" " " "
" + NaNO ₃	" " " "

HYDROGEN PHOSPHIDE (Phosphine) H₃P

One liter of Cyclo Hexanol (C₆H₁₁OH) dissolves 2.856 cc H₃P at 26° and 766 mm. Hg pressure. ((Cauquil, 1927.)

HYDROGEN PHOSPHITE (Phosphorus Acid) H_3PO_3

Freezing-point data are given by Redfield and King, 1936, for each of the following mixtures.

H_3PO_3 + CH_3COOH (Acetic acid)	H_3PO_3 + $\text{C}_6\text{H}_5\text{COCH}_3$ (Acetophenone)
" + CCl_3COOH (Trichlor Acetic Acid)	" + $(\text{CH}_2\text{O})_2\text{C}_6\text{H}_5\text{CHO}$ (Piperonal)
" + $\text{CH}_3\text{COCOCH}_3$ (Pyruvic acid)	" + $\text{C}_6\text{H}_5\text{CH:CH.OCO}$ (Coumarin)
" + $\text{C}_6\text{H}_5\text{COOH}$ (Phenol)	

HYDROGEN PHOSPHATE (Phosphoric Acid)

PO

PHOSPHORIC ACID (ortho) H_3PO_4 .

SOLUBILITY IN WATER. (Smith and Menzies, 1909.)

(The sat. solutions were analyzed by titration. The mixtures were constantly stirred for at least two hours.)

t°.	Gms. H_3PO_4 per 100 Gms. Sat. Sol.	Solid Phase.	t°.	Gms. H_3PO_4 per 100 Gms. Sat. Sol.	Solid Phase.
-81*	62.9	Ice + 2 $\text{H}_3\text{PO}_4 \cdot \text{H}_2\text{O}$	24.38	94.80	10 $\text{H}_3\text{PO}_4 \cdot \text{H}_2\text{O}$
-16.3	76.7	2 $\text{H}_3\text{PO}_4 \cdot \text{H}_2\text{O}$	24.40	94.84	"
+0.5	78.7	"	24.81	94.95	"
14.95	81.7	"	25.41	95.26	"
24.03	85.7	"	25.85	95.54	"
27	87.7	"	26.2*	...	" + H_3PO_4
29.15	90.5	"	26.23	95.90	H_3PO_4
29.35†	91.6	"	27.02	95.98	"
28.5	92.5	"	29.42	96.15	"
27	93.4	"	29.77	96.11	"
25.4	94.1	"	37.65	97.80	"
23.5*	...	" + 10 $\text{H}_3\text{PO}_4 \cdot \text{H}_2\text{O}$	39.35	98.48	"
24.11	94.78	10 $\text{H}_3\text{PO}_4 \cdot \text{H}_2\text{O}$	42.30†	100	"

* Eutec.

† M. pt.

NOTE. — The results of Giran (1908), determined by the freezing-point method, are shown to be erroneous, due to supercooling which would result from failure to induce crystallization by inoculation.

F-pt. data for mixtures of phosphoric and phosphorus acids are given by Rosenheim, Stadler and Jakobsohn (1906).

SOLUBILITY OF ORTHO PHOSPHORIC ACID IN WATER. (Ross and Jones, 1925.)

The mixtures were stirred at constant temperature for at least three days. The analysis was made by titrating with standard Na OH solution, using phenolphthalein as indicator.

t°.	Gms. H_3PO_4 per 100 gms. sat. sol.	Solid Phase.	t°.	Gms. H_3PO_4 per 100 gms. sat. sol.	Solid Phase.
-85 (Eutec.)	62.5	$Ice + 2H_3PO_4 \cdot H_2O$	28.28.....	92.72	$2H_3PO_4 \cdot H_2O$
-57.....	67.0	$2H_3PO_4 \cdot H_2O$	27.36.....	93.33	"
-43.....	70.0	"	26.08.....	93.74	"
-29.0.....	72.5	"	23.50 (Eutec.)	94.75	" + H_3PO_4
-17.5.....	75.0	"	25.88.....	95.22	H_3PO_4
0.0.....	78.75	"	27.30.....	95.56	"
18.92.....	84.07	"	28.38.....	95.86	"
23.41.....	85.93	"	29.90.....	96.18	"
25.24.....	87.05	"	31.96.....	96.80	"
27.30.....	88.51	"	34.06.....	97.40	"
28.75.....	90.00	"	36.15	98.00	"
29.32 m. pt.	91.60	"	40.02.....	99.27	"
28.80.....	92.30	"	42.35 m. pt.	100.00	"

The authors failed to find the decahydrate reported by Smith and Menzies, 1909

100 gms. sat. solution of $2H_3PO_4 \cdot H_2O$ in water contain 85.95 gms. H_3PO_4 at 25°. (Grube and Staesche, 1927.)

PO

FREEZING-POINTS OF AQUEOUS SOLUTIONS OF PHOSPHORIC ACID. (Ross and Jones, 1925.)

t°.	Gms. H_3PO_4 per 100 gms. sat. sol.	Solid Phase.	t°.	Gms. H_3PO_4 per 100 gms. sat. sol.	Solid Phase.
-5.....	17.5	Ice	-35.....	47.5	Ice
-10.....	27.0	"	-45.....	51.0	"
-15.....	34.0	"	-60.....	55.0	"
-20.....	38.0	"	-75.....	59.5	"
-25.....	42.0	"	-85 (eutec.)	62.5	" + $2H_3PO_4 \cdot H_2O$

SOLUBILITY OF ORTHO PHOSPHORIC ACID IN ETHYL ETHER.

(Rabinowitsch and Jakobssohn, 1923.)

t°	Gms. H_3PO_4 per 100 gms. sat. sol.	Solid Phase	t°	Gms. H_3PO_4 per 100 gms. sat. sol.	Solid Phase
14.0	82.50	$4H_3PO_4 \cdot (C_2H_5)_2O$	25.5	89.10	$6H_3PO_4 \cdot (C_2H_5)_2O$
17.2	83.48	"	22.1	89.50	"
39.3 (m.pt.)	84.20	"	17.5	89.85	"
30.0	84.38	"	16.0 (Eutec.)	90.10	" + H_3PO_4
28.4	84.96	"	16.9	91.7	H_3PO_4
27.5	87.00	"	17.7	92.5	"
25.2	87.48	"	21.0	95.10	"
23.9	87.70	"	23.4	96.17	"
22.0 (Eutec.)	—	" + $6H_3PO_4 \cdot (C_2H_5)_2O$	26.5	97.20	"
24.5	88.05	$6H_3PO_4 \cdot (C_2H_5)_2O$	28.3	97.85	"
25.2	88.10	"	28.7	97.93	"
28.2 (m.pt.)	88.80	"	30.1	98.50	"
27.5	88.94	"	38.4	100.00	"

Freezing-point data are given by King and Walton, 1931, for each of the following mixtures

H_3PO_4 + CH_3COOH (acetic acid)	H_3PO_4 + C_6H_5CHO (Benzaldehyde)
" + C_2H_5COOH (Propionic acid)	" + $CH_3OC_6H_4CHO$ (Anisaldehyde)
" + C_3H_7COOH (n Butyric acid)	" + $C_6H_5COCH_3$ (Acetophenone)
" + $CH_3(CH_2)_4COOH$ (n Caproic acid)	" + $C_6H_5COC_6H_5$ (Benzo aceto phenone)
" + C_6H_5COOH (Benzoic acid)	" + C_6H_5OH (Phenol)
" + $C_2H_3COCOOH$ (Pyruvic acid)	" + $C_6H_4OH.OCH_3$ (Guaicol)
" + $CH_2ClCOOH$ (Monochlor acetic acid)	" + $C_6H_4CH:CH.OO$ (Cumarin)
" + $CH_2C_6H_5COOH$ (Phenylacetic acid)	

PO PyroPHOSPHORIC ACID $H_4P_2O_7$.

SOLUBILITY IN WATER. (Giran, 1908; see note on preceding page.)

t°.	Gms. $H_4P_2O_7$ per 100 Gms. Sat. Sol.	Solid Phase.
-75	59	Ice + $H_4P_2O_7 \cdot 1\frac{1}{2}H_2O$
+26 m. pt.	86.8	$H_4P_2O_7 \cdot 1\frac{1}{2}H_2O$
23	88.8	" + $H_4P_2O_7$
61 m. pt.	100	$H_4P_2O_7$

HypoPHOSPHORIC ACID $H_2PO_3 \cdot H_2O$.

100 gms. sat. solution in water contain 81.8 gms. H_2PO_3 at the m. pt., 62°, of the hydrated compound, $H_2PO_3 \cdot H_2O$. (Rosenheim and Pritze, 1908.)

HYDROGEN SULFIDE H_2S .

SOLUBILITY IN WATER.

(Winkler, 1906, 1912.)

t°.	Abs. Coef. β .	q.	t°.	Abs. Coef. β .	q.	t°.	Abs. Coef. β .	q.
0	4.621	0.699	25	2.257	0.334	60	1.176	0.146
5	3.935	0.593	30	2.014	0.295	70	1.010	0.109
10	3.362	0.505	35	1.811	0.262	80	0.906	0.076
15	2.913	0.436	40	1.642	0.233	90	0.835	0.041
20	2.554	0.380	50	1.376	0.186	100	0.800	0

Abs. Coef β shows the vol. of H_2S (reduced to 0° & 760mm) absorbed by 1 vol. of H_2O when the pressure of the gas without the tension of the liquid amounts to 760mm.

q is the weight of H_2S in grams which is taken up by 100 grams of H_2O at the given temperature and total pressure (partial pressure of gas + vapor pressure of the liquid) is 760mm.

THE SOLUBILITY OF HYDROGEN SULFIDE IN WATER AS MEASURED BY THE
VAPOR PRESSURES OF THE SOLUTIONS.

(Wright and Maass, 1932.)

A new type of glass diaphragm manometer was used for determination of the equilibrium pressures of known mixtures of $H_2S + H_2O$, confined in an all glass cell. This obviated stray reactions between the gas and Hg or stopcock grease. The results show that Henry's Law is not strictly obeyed.

t°	Pressure in mm. Hg		Gm. Mols. H_2S per liter of		Partition Coef. s/v
	Total	Partial	Vapor Phase(v)	Aq. Solution(s)	
5	274.5	268.0	0.0155	0.0635	4.09
"	560.0	553.0	0.0321	0.1302	4.06
"	838.0	831.0	0.0484	0.1910	3.94
"	1176.0	1169.0	0.0685	0.2682	3.92
10	303.8	294.7	0.0168	0.0597	3.56
"	615	606	0.0346	0.1220	3.52
"	914	905	0.0518	0.1801	3.47
"	1279	1270	0.0731	0.2511	3.44
"	1567	1558	0.0900	0.3060	3.40
"	2112	2103	0.1221	0.4099	3.36
20	362.8	345.4	0.0190	0.0528	2.78
"	724	707	0.0390	0.1074	2.76
"	1067	1050	0.0581	0.1594	2.74
"	1483	1466	0.0816	0.2188	2.68
"	1817	1800	0.1005	0.2696	2.68
"	2454	2437	0.1371	0.3642	2.66
30	422.8	391.3	0.0208	0.0470	2.26
"	830	798	0.0425	0.0955	2.25
"	1219	1187	0.0636	0.1413	2.22
"	1674	1640	0.0882	0.1932	2.19
"	2052	2020	0.1091	0.2398	2.20
"	2785	2753	0.1498	0.3247	2.17
40	486.5	431.6	0.0222	0.0426	1.92
"	934	879	0.0454	0.0858	1.89
"	1370	1315	0.0682	0.1260	1.85
"	1853	1798	0.0937	0.1722	1.84
"	2278	2223	0.1162	0.2149	1.85
"	3095	3040	0.1603	0.2921	1.82
60	652.2	503.3	0.0243	0.0359	1.48
"	1162	1013	0.0492	0.0730	1.48
"	1681	1532	0.0747	0.1045	1.40
"	2213	2064	0.1010	0.1440	1.42
"	2731	2582	0.1269	0.1777	1.40
"	3707	3558	0.1762	0.2426	1.38

The PT and the Px curves for the system $H_2S + H_2O$ are given by Sheffer, 1911.

SOLUBILITY OF HYDROGEN SULFIDE IN WATER AND IN RUBBER.

(Venable and Fuwa, 1922.)

The gas dissolved by a given amount of air free rubber was pumped out with a Tüpler pump and measured over mercury.

100 cc. H_2O dissolve 243 cc. (at 0° and 760 mm) H_2S at 21°
 » Rubber » 273 cc. (» » ») » »

SOLUBILITY OF HYDROGEN SULFIDE IN AQUEOUS SOLUTIONS OF HYDROCHLORIC ACID
AT 25°. (Kendall and Anderson, 1921.)

Normality of aq. HCl solutions.	Cc. H ₂ S (at 0° and 760 mm.) dissolved by 1 cc. sat. sol. (at 760 mm. pressure).		Normality of aq. HCl solutions.	Cc. H ₂ S (at 0° and 760 mm.) dissolved by 1 cc. sat. sol. (at 760 mm. pressure).	
	Gm. mols. H ₂ S per liter sat. sol.			Gm. mols. H ₂ S per liter sat. sol.	
0.0 (= H ₂ O).	0.1023	2.266	2.498.....	0.1030	2.281
0.1348.....	0.1018	2.253	3.040.....	0.1034	2.291
0.2828.....	0.1015	2.247	3.308.....	0.1039	2.301
0.6308.....	0.1016	2.250	4.410.....	0.1076	2.384
1.180.....	0.1020	2.260	4.874.....	0.1090	2.413
1.848.....	0.1026	2.272			

SOLUBILITY OF HYDROGEN SULFIDE IN AQUEOUS SOLUTIONS OF HYDRIODIC
ACID AT 25° AND 760 MM. TOTAL PRESSURE.
(Pollitzer, 1909.)

Mols. per Liter.			Gms. per Liter.		Mols. per Liter.			Gms. per Liter.	
[H ⁺].	[HI].	[H ₂ S].	HI.	H ₂ S.	[H ⁺].	[HI].	[H ₂ S].	HI.	H ₂ S.
0.20	0	0.1040	0	3.54	4.71	4.38	0.163	560.4	5.55
1.23	1.01	0.111	129.2	3.78	5.33	5.005	0.165	640.3	5.62
1.74	1.51	0.113	193.2	3.85	6.06	5.695	0.181	728.6	6.17
2.18	1.93	0.125	246.9	4.26	7.33	6.935	0.197	887.2	6.71
2.92	2.64	0.138	337.8	4.70	9.75	9.21	0.267	1179	9.10
3.71	3.42	0.142	437.5	4.84					

Data for the solubility of hydrogen sulfide in liquid sulfur are given by Pelabon, 1897.

Freezing-point lowering data for mixtures of H₂S and CH₃OH and H₂S and (CH₃)₂O are given by Baume and Perrot, 1911, 1914.

SOLUBILITY OF HYDROGEN SULFIDE IN AQUEOUS SALT SOLUTIONS AT 25°.

(McLauchlan, 1903.)

NOTE. — The original results are given in terms of $\frac{l}{l_0}$ which is the iodine titer (l) of the H₂S dissolved in the salt solution, divided by the titer (l_0), of the H₂S dissolved in pure water. These figures were multiplied by 2.61 (see 25° result in last table on page 322) and the products recorded in the following table as volumes of H₂S absorbed by 1 vol. of aqueous solution.

Solution.	Grams Salt per Liter.	$\frac{l}{l_0}$	Vols. H ₂ S per 1 Vol. Sol.	Solution.	Grams. Salt per Liter.	$\frac{l}{l_0}$	Vols. H ₂ S per 1 Vol. Sol.
<i>n</i> NH ₄ Br	98	1	2.61	<i>n</i> KBr	119	0.945	2.47
<i>n</i> NH ₄ Cl	53.4	0.96	2.40	<i>n</i> KCl	74.5	0.853	2.22
<i>n</i> NH ₄ NO ₃	80	0.99	2.58	<i>n</i> KNO ₃	101	0.913	2.38
$\frac{1}{2}$ <i>n</i> (NH ₄) ₂ SO ₄	33	0.82	2.14	$\frac{1}{2}$ <i>n</i> K ₂ SO ₄	43.5	0.78	2.04
$\frac{1}{4}$ <i>n</i> (NH ₄) ₂ SO ₄	16.5	0.91	2.37	$\frac{1}{4}$ <i>n</i> K ₂ SO ₄	21.7	0.80	2.32
<i>n</i> NH ₄ C ₂ H ₃ O ₂	77.1	1.09	2.84	<i>n</i> KI	166	0.98	2.56
<i>n</i> (NH ₄) ₂ CO	60.1	1.02	2.66	<i>n</i> NaBr	103	0.935	2.44
$\frac{1}{2}$ <i>n</i> HCl	18.22	0.975	2.54	<i>n</i> NaCl	58.5	0.847	2.21
$\frac{1}{2}$ <i>n</i> H ₂ SO ₄	24.52	0.905	2.36	$\frac{1}{2}$ <i>n</i> NaCl	29.2	0.93	2.42
<i>n</i> C ₂ H ₅ O ₄	150	0.944	2.46	<i>n</i> NaNO ₃	85	0.803	2.32
$\frac{3}{4}$ <i>n</i> C ₂ H ₅ O ₆	450	0.858	2.24	$\frac{1}{2}$ <i>n</i> Na ₂ SO ₄	35.5	0.73	1.90
Pure C ₂ H ₅ (OH) ₃	1000	0.863	2.26	$\frac{1}{4}$ <i>n</i> Na ₂ SO ₄	17.8	0.855	2.23

Similar data are also given for the solubility of H₂S in aq. C₂H₅OH solutions and in aq. CH₃COOH solutions at 25°.

SOLUBILITY IN WATER AND IN ALCOHOL AT t° AND 760 MM. PRESSURE.
(Bunsen and Carius; Fauser, 1888.)

In Water.					In Alcohol.	
t°.	1 Vol. H ₂ O Absorbs.	β .	η .	1 Vol. Alcohol Absorbs.		
0	4.37 Vols. H ₂ S (at 0° and 760 mm.)	4.686	0.710	17.89 Vols. H ₂ S (at 0° and 760 mm.)		
5	3.97 "	4.063	0.615	14.78 "		
10	3.59 "	3.520	0.530	11.99 "		
15	3.23 "	3.056	0.458	9.54 "		
20	2.91 "	2.672	0.398	7.42 "		
25	2.61 "	...	...	5.96 (24°)	"
30	2.33 "	...	...	...
35	2.08 "	...	...	...
40	1.86 "	...	...	...

For definition of β and η see Solubility of Hydrogen Sulfide in Water.

SOLUBILITY OF HYDROGEN SULFIDE IN SEVERAL SOLVENTS AT 20° AND 760MM.
(Bell, 1931.)

The solvents were saturated by bubbling H₂S through them for about 3 hours, using some 8-10 times as much gas as required for saturation. The dissolved gas was determined by displacing it with a current of CO₂ free air and absorbing the H₂S in a known volume of normal NaOH containing an excess of 30% H₂O₂ above that required for oxidation to sulfate. After absorption the excess of H₂O₂ was removed by heating to $60-70^{\circ}$ and the excess of alkali was titrated with normal HCl.

S

Solvent	S	X	Solvent	S	X
Hexane	6.30	0.0341	Penta chlor Ethane	10.63	0.0514
Octane	6.80	0.0440	Bromoform	16.76	0.0581
Dodecane	5.71	0.0513	Ethyl bromide	17.80	0.0608
Cetane	5.05	0.0578	Chloroform	32.8	0.103
Cyclo Hexane	7.50	0.0338	Bromo Benzene	12.92	0.0376
Carbon tetrachloride	10.79	0.0419	Chloro Benzene	13.80	0.0388
Benzene	15.68	0.0563	Tetrabrom Ethane(s)	9.49	0.0446
Toluene	16.90	0.0672	Tetra chlor Ethane(s)	16.66	0.0702
Tetra chlor Ethylene	8.90	0.0372	Ethyl bromide	43.3	0.126
Tri chlor Ethylene	13.16	0.0482	Ethylene chloride	23.0	0.0719

S = the partition coefficient of H₂S between the liquid and the vapor; that is $S = C$ (the gm. equiv. per liter) \div 0.0417, since $S/C = 22.4 \times 293/273$.

X = the Mol. Fraction Solubility calculated on the assumption that the densities obey the ideal mixture law.

At pressures between 0 and 15 Atmospheres, the Solubility of H₂S in Gas Oil ($d = 0.8319$ and vapor pressure of 2mm at 25°) is expressed by the equation $y = 4.17 (x + 1.7)$.

At pressures between 0 and 9 Atmospheres, the Solubility of H₂S in Heavy Naphtha ($d = 0.8003$ and vapor pressure of 80mm at 25°) is expressed by the equation $y = 5.5(x)$.

In these equations y = Volume of H₂S at 25° and 1 atm. dissolved per 1 vol. of liquid.

X = Absolute pressure in atmospheres. (Frolich, Touch, Hogan and Peer, 1931.)

HYDROGEN SULFIDE

Freezing-point Data have been determined for the following mixtures:

$\text{H}_2\text{S} + \text{CCl}_4$	(Biltz and Brautigan, 1927.)
" + CS_2	" " " "
" + SO_2	" " " "
" + NH_3	(Sheflan and McCrosky, 1932.)
" + CH_3OH	(Baume & Perrot, 1914; Baume et al, 1914.)
" + $(\text{CH}_3)_2\text{O}$	(Baume & Perrot, 1914.)

HYDROGEN Di and TriSULFIDES H_2S_2 and H_2S_3 .

Freezing-point Data for mixtures of $\text{H}_2\text{S}_3 + \text{S}$ are given by Butler and Maass, 1930, and for $\text{H}_2\text{S}_3 + \text{S}$ by Walton and Whitford, 1930.)

HYDROGEN SULFATE (Sulfuric Acid) H_2SO_4

SO

FREEZING-POINTS OF MIXTURES OF SULFURIC ACID AND WATER.

(Hilsmann and Biltz, 1934.)

The many difficulties which interfere with the accuracy of determination are described. The temperatures were measured with a thermoelement. The authors' original results were plotted and the following values read from the curves.

t°	Gms. H_2SO_4 per 100 gms. sat. sol.	Solid Phase	t°	Gms. H_2SO_4 per 100 gms. sat. sol.	Solid Phase
-4.0	10.0	Ice	-47.2 (Eutec)	68.0	$\text{H}_2\text{SO}_4 \cdot 4\text{H}_2\text{O} + \text{H}_2\text{SO}_4 \cdot 2\text{H}_2\text{O}$
-15.0	20.0	"	-45	69.0	$\text{H}_2\text{SO}_4 \cdot 2\text{H}_2\text{O}$
-35.0	30.0	"	-42	70.0	"
-55.0	35.0	"	-40	71.5	"
-72.4 (Eutec)	36.5	" + $\text{H}_2\text{SO}_4 \cdot 8\text{H}_2\text{O}$	-39 (m. pt.)	73.1	"
-67.5	37.2	$\text{H}_2\text{SO}_4 \cdot 8\text{H}_2\text{O}$	-39.5 (Eutec)	73.5	" + $\text{H}_2\text{SO}_4 \cdot \text{H}_2\text{O}$
-63.7	37.8	"	-30	74.5	$\text{H}_2\text{SO}_4 \cdot \text{H}_2\text{O}$
-62.0	38.2	" + $\text{H}_2\text{SO}_4 \cdot 6\text{H}_2\text{O}$	-20	76.0	"
-60	38.5	$\text{H}_2\text{SO}_4 \cdot 6\text{H}_2\text{O}$	-10	78.3	"
-58	39.0	"	0	81.0	"
-55	40.5	"	+8.5 (m. pt.)	84.5	"
-54	42.0	" + $\text{H}_2\text{SO}_4 \cdot 4\text{H}_2\text{O}$	0	88.5	"
-50	43.5	$\text{H}_2\text{SO}_4 \cdot 4\text{H}_2\text{O}$	-10	91.0	"
-40	48.0	"	-20	92.5	"
-30	55.0	"	-35.5 (Eutec)	93.5	" + H_2SO_4
-28.5 (m. pt.)	57.65	"	-20	95.5	H_2SO_4
-30.0	60.0	"	-10	97.0	"
-35.0	64.0	"	0	98.5	"
-40.0	66.0	"	+10.49	100.0	"

SOLUBILITY OF SULFURIC ACID IN WATER, DETERMINED BY THE
FREEZING-POINT METHOD.

t°.	Gms. H ₂ SO ₄ per 100 Gms. Sat. Sol.	Gms. SO ₃ per 100 Gms. Sat. Sol.	Solid Phase.	t°.	Gms. H ₂ SO ₄ per 100 Gms. Sat. Sol.	Gms. SO ₃ per 100 Gms. Sat. Sol.	Solid Phase.
-10	16.25	13.25 (1) (5)	Ice	-10	77.75	63.5 (3)	SO ₃ ·2H ₂ O
-20	24	19.5 (1) (2) (3)	"	-20	80.25	65.5 (2)	"
-30	28.5	23.25 (2)	"	+ 8.35*	84.5	68.98 (2)	"
-40	31.25	25.5 (2)	"	8.81	84.5	68.98 (1)	"
-50	33.5	27.25 (1) (2)	"	o	88.25	72 (2)	"
-60	35.25	28.75 (1)	"	-20	91.5	74.75 (1)	"
-70	36.75	30 (2)	"	-30	92.5	75.5 (1)	"
-75	38	31 (2)	" + SO ₃ ·5H ₂ O	-38	93	76 (2)	" + SO ₃ ·H ₂ O
-70	39	31.75 (2)	SO ₃ ·5H ₂ O	-30	93.75	76.5 (4)	SO ₃ ·H ₂ O
-60	41.5	33.75 (2)	"	-20	95.25	77.75 (4)	"
-50	44	36 (2)	"	-10	96.25	78.5 (1) (4)	"
-40	47.75	39 (2)	"	o	97.75	79.75 (4)	"
-30	53.25	43.25 (2)	"	+10	99.75	81 (4)	"
-25*	57.65	47.06 (2)	"	10.35	100	81.62 (1) (3) (7) (4)	"
-30	61	49.75 (2)	"	10	...	82 (4)	"
-40	65.25	53.25 (2)	"	o	...	83.25 (4)	"
-60	70.75	57.75 (3)	" (unstable)	-10	...	84.5 (4)	"
-70	73.25	59.75 (3)	" " + SO ₃ ·2H ₂ O	-12	...	85 (4)	" + SO ₃ ·½H ₂ O
-60	73.50	60 (3)	SO ₃ ·2H ₂ O (unstable)	-10	...	85.25 (4)	SO ₃ ·½H ₂ O
-50	74.25	60.5 (3)	"	o	...	86 (4)	"
-50	68	55.5 (2)	SO ₃ ·5H ₂ O + SO ₃ ·3H ₂ O	+10	...	86.75 (4)	"
-45	68.5	56 (6)	SO ₃ ·3H ₂ O	20	...	87.5 (4)	"
-40	71	58 (6)	"	30	...	88.5 (4)	"
-38.9*	73.14	59.69 (6)	"	36*	...	89.89 (4)	"
-40	74.25	60.5 (6)	"	30	...	90.5 (4)	"
-41	74.75	61 (6)	" + SO ₃ ·2H ₂ O	20	...	91.5 (4)	"
-40	74.75	61 (4)	SO ₃ ·2H ₂ O	10	...	92.25 (4)	"
-30	75.25	61.5 (4)	"	6.5	...	93 (4)	" + (?)
-20	76.5	62.5 (3)	"				

* m. pt.

(1) = Pfandler and Schnegg (1875); (2) = Pickering (1890); (3) = Thilo (1892); Pictet (1894); (4) = Knietzsch (1901); (5) = Rüdorff (1862); (6) = Biron (1899); (7) = Marignac (1853). See also Pickering (1890-91); Lespieau (1894) and Giran (1913).

SOLUBILITY OF SULFURIC ACID IN BENZENE SOLUTIONS OF VALERIC
ACID AT 18°.

(Gurwitsch, 1914.)

The mixtures were shaken with excess of 95.8% H₂SO₄ at 0° and then brought to equilibrium at 18°.

Gms. Valeric Acid per 100 Gms. Valeric Acid + Benzene.	Gms. H ₂ SO ₄ per 100 Gms. of the Sat. Solution.
o = Pure benzene	o
0.584	0.052
1.62	0.104
3.64	0.226
7.60	0.378
17.5	0.454

H HYDROGEN

600

EQUILIBRIUM IN THE SYSTEM SULFURIC ACID, NITROBENZENE AND WATER AT 17°.
(Bailey and Hilton, 1936.)

Weighed quantities of two of the components were mixed and the third (usually water) added until opalescence appeared. A perfectly sharp end point was usually obtained.

Gm. Mols. per 100 gm. Mols. of the three constituents			Gm. Mols. per 100 gm. Mols. of the three constituents			Gm. Mols. per 100 gm. Mols. of the three constituents		
$C_6H_5NO_2$	H_2O	H_2SO_4	$C_6H_5NO_2$	H_2O	H_2SO_4	$C_6H_5NO_2$	H_2O	H_2SO_4
0.054	84.9	15.0	6.52	44.6	48.9	46.3	17.1	36.6
0.084	80.7	19.2	8.9	42.1	49.0	48.4	16.7	34.9
0.32	66.2	33.5	15.1	36.0	48.9	64.1	10.2	25.7
0.88	57.4	41.7	17.1	34.5	48.4	76.6	5.5	17.9
1.59	53.7	44.7	19.2	32.5	48.3	86.4	3.0	10.6
2.34	51.3	46.4	26.3	27.5	46.2	97.6	0.41	2.02
4.24	48.0	47.8	32.7	23.5	43.8	98.6	1.4	—
						0.03	99.99	—

SO

* These two results by Davis, 1916

Experimental determinations by the method of Alexieff of Equilibrium in the System Sulfuric Acid, Phenol and Water are given by Svecova, 1938.

Results for the distribution of H_2SO_4 between Water and Phenol, at 17° are given by Wosnessersky and Astachow, 1925.

Freezing-point data have been determined for the following mixtures:

H_2SO_4 + $ZnSO_4$ and other sulfates (Kendall and Davidson, 1921.)	
" + Phenol (Kendall and Carpenter, 1914; Kendall and Landon, 1920; Kendall and Davidson, 1921.)	
" + Nitrobenzene (Masson, 1931.)	
" + Amyl alcohol (Archibald, 1932.)	
" + Tertiary Amyl Alcohol " "	
" + n Butyl Alcohol " "	
" + Acetic acid and long series of Organic Compounds (Kendall and Carpenter, 1914; Atsuki and Isshi, 1931.)	

HYDROGEN SELENIDE H_2Se

SOLUBILITY IN WATER.

(de Forcrand and Fonzees-Diacon, 1902.)

t°	4°	9.65	13.2	22.5
Vol. H_2Se (at 0° and 760 mm.) dissolved per 1 vol. H_2O	3.77	3.45	3.31	2.70

SeO

SOLUBILITY OF HYDROGEN SELENIDE IN WATER AND IN AQUEOUS SOLUTIONS OF HYDRIODIC ACID AT A PARTIAL PRESSURE OF H_2Se OF 760 MM.

(Mc Amis and Felsing, 1925.)

Solubility in Water.

Solubility in Aq. HI Solut. at 25°.

t°	Mols. H_2Se per liter sat. sol.	Gc. H_2Se (at 0° and 760 mm.) per liter sat. sol.	Mols. HI per liter.	Mols. H_2Se per liter sat. sol.	Gc. H_2Se (at 0° and 760 mm.) per liter sat. sol.
14.6...	0.09789	2194	0.20	0.08478	1900
15.0....	0.09611	2154	0.40	0.08634	1935
25.0....	0.08415	1886	2.73	0.11012	2468
25.6....	0.08277	1855			
35.0....	0.07317	1640			

HYDROGEN SELENITE (Selenious Acid) H_2SeO_3 .**SOLUBILITY IN WATER.**

(Etard, 1894.)

t°.	Gms. H_2SeO_3 per 100 Gms. Solution.	t°.	Gms. H_2SeO_3 per 100 Gms. Solution.	t°.	Gms. H_2SeO_3 per 100 Gms. Solution.
-10	42.2	25	67	60	79.3
0	47.4	30	70.2	70	79.3
+10	55	40	77.5	80	79.3
20	62.5	50	79.2	90	79.4

HYDROGEN SELENATE (Selenic Acid) H_2SeO_4 .**SOLUBILITY IN WATER, DETERMINED BY FREEZING-POINT METHOD.**

(Kremann and Hofmeier, 1908.)

t°.	Gms. H_2SeO_4 per 100 Gms. Sat. Sol.	Solid Phase.	t°.	Gms. H_2SeO_4 per 100 Gms. Sat. Sol.	Solid Phase.	SeO
0	0	Ice	-55	71.5	$\text{H}_2\text{SeO}_4 \cdot 4\text{H}_2\text{O}$	
-10	21	"	-65 Eutec.	74	" + $\text{H}_2\text{SeO}_4 \cdot \text{H}_2\text{O}$	
-20	30	"	-50	75.5	$\text{H}_2\text{SeO}_4 \cdot \text{H}_2\text{O}$	
-30	36	"	-20	79	"	
-40	40	"	0	81	"	
-50	42.5	"	+20	85	"	
-60	45	"	26 m. pt.	88	"	
-80	48	"	20	91	"	
-95 Eutec.	50	" + $\text{H}_2\text{SeO}_4 \cdot 4\text{H}_2\text{O}$	16 Eutec.	91.5	" + H_2SeO_4	
-80	52	$\text{H}_2\text{SeO}_4 \cdot 4\text{H}_2\text{O}$	30	93	H_2SeO_4	
-70	54	"	40	94.5	"	
-60	58	"	50	96.5	"	
-51 m. pt.	67	"	60	100	"	

FREEZING-POINTS OF MIXTURES OF SELENIC ACID AND SULFUR TRIOXIDE.

(Meyer and Staszczny, 1922.)

A diagram is given and the following numerical data for the principal points of the diagram.

t°.	Gms. SO_3 per 100 gms. mixture.	Solid Phase.	t°.	Gms. SO_3 per 100 gms. mixture.	Solid Phase.
58.....	0.0	H_2SeO_4	-8.0 Eutec.	40.4	$\text{H}_2\text{SeSO}_7 + \text{H}_2\text{SeS}_2\text{O}_{10}$
-12 Eutec.	23.0	" + H_2SeSO_7	19.0 m. pt.	53.0	$\text{H}_2\text{SeS}_2\text{O}_{10}$
+ 6.6 m. pt.	35.0	H_2SeSO_7	-7.0 Eutec.	63.9	" - SO_3

HYDROGEN SILICIDE H Si

One liter of Cyclo Hexanol ($\text{C}_6\text{H}_{12}\text{OH}$) dissolves 97cc. HSi at 26° and 765mm. (Cauquil, 1927.)

Si

HELIUM He.**SOLUBILITY OF HELIUM IN WATER.** (von Antropoff, 1925.)

New determinations made with a highly refined apparatus and with the greatest possible accuracy, gave the following values, which are expressed in terms of the Bunsen absorption coefficient, as modified by Kuenen to show the volume of gas (reduced to 0° and the 760 mm) dissolved by 1.0 gm. of H_2O .

t°.....	0°.	10°.	20°.	30°.	40°.	50°.
Absorption coef.....	0.0097	0.0099	0.0100	0.0101	0.0103	0.0108

SOLUBILITY OF HELIUM IN WATER. (Cady, Elsey and Berger, 1922.)

The following very carefully determined results are given in terms of the Ostwald solubility expression $\alpha = \frac{273.1 \times V_1}{T \times V}$, in which V = the volume of H₂O, V₁ = the volume of helium absorbed by V volumes of H₂O and T = temp. on the absolute scale.

t°.....	2°0.	10°.	25°.	30°.
α	0.00937	0.00895	0.00860	0.00817

According to Venable and Fuwa, 1923, 100 cc. of H₂O dissolve 1.4 cc. He (reduced to 0° and 760 mm.) at 21°. These authors also found that 100 cc. of rubber dissolve about 1.0 cc. of helium at 21°, as determined by pumping out the gas with a Tüpler pump and measuring it over mercury.

SOLUBILITY OF HELIUM IN WATER.

(Lannung, 1930.)

The results are in terms of the Bunsen Absorp. Coef. β and the Ostwald Solubility Expression $l = \frac{\beta}{W_L \times P} \times \frac{(W + w) P_0}{P}$, where W and w are the volumes

of He originally introduced and remaining after absorption (reduced to 0° and 760 mm). W_L is the volume of H₂O at the temp. of saturation. P is the partial pressure of He in mm Hg and P₀ is 760 mm. l = the equilibrium distribution ratio of the volume concentration of He in the solution and in the vapor phase.

He

t°	β	l
15	0.0089	0.0094
20	0.0088	0.0095
25	0.0087	0.0095
30	0.0086	0.0095
37	0.0084	0.0095

The older results of Streicher, 1899, are considered to be too high due to inaccuracies in the method of determination.

SOLUBILITY OF HELIUM IN WATER AT PRESSURES UP TO 1000 ATMOSPHERES.

(Wiebe and Gaddy, 1935.)

The authors used a simple bubbling-type of apparatus made of a steel cylinder with pressure valves. Equilibrium was approached from both lower and higher pressures. The helium was 99.95% pure. It was found that 1% N impurity had a very decided effect upon raising the solubility, but 0.05% was negligible.

Partial Pressure of He in Atmospheres	cc He ₂ (reduced to 0° and 760 mm) dissolved per 1.0 gm. H ₂ O at:			
	00	250	500	750
25	0.2322	0.2156	0.2225	0.2442
50	0.4674	0.4332	0.4445	0.4892
100	0.9240	0.8491	0.8827	0.9699
200	1.807	1.688	1.734	1.907
400	3.436	3.241	3.358	3.666
600	4.916	4.681	4.844	5.277
800	6.228	6.015	6.248	6.787
1000	7.421	7.263	7.536	8.251

The averages of the 25 and 50 atm. values were used to compute the Bunsen and Ostwald coefficients. The values thus obtained were found to be in good agreement with the results of Cady, Elsey and Berger, 1922, and Lannung, 1930.)

SOLUBILITY OF HELIUM IN WATER AND IN WHOLE BLOOD AT 38°.

(Hawkins and Shilling, 1936.)

The blood of oxen or dogs was oxalated with 0.02 percent oxalate and used immediately or chilled to nearly 0° and used the next day. The time allowance for saturation was 30 minutes. The O capacity of the blood samples varied from 18 to 21.5 vol. percent. The H₂O content from 0.77 to 0.89 gm. per cc.

Results for H₂O

He pressure in mm. Hg	He content in Vol. Percent
723	0.80
1495	1.68
3025	3.41
4620	5.20

Results for Ox and Dog Blood

He Pressure in mm. Hg	He Content in Vol. Percent
699	0.83
1466	1.70
3028	3.54
4556	5.59

The solubility coefficient for He in Water is 0.085 and that for dog blood was found to vary from 0.083 to 0.089 and that for ox blood to vary from 0.080 to 0.091. The amount of helium dissolved by whole blood under helium pressures varying from 1 to 6 atmospheres (absolute) was found to be directly proportional to the helium pressure in accordance with Henry's law.

SOLUBILITY OF HELIUM IN AQUEOUS SOLUTIONS OF SALTS AT 25°.

(Ekerlof, 1935.)

He

Aqueous Solutions of:	Gm. mols. Salt per 1000 gm. H ₂ O	cc He ₂ (at 0° and 760mm.) in an amt. of solution containing 1.0 gm. H ₂ O
Potassium Chloride	4.72	0.0048
Sodium Chloride	5.81	0.0043
Lithium Chloride	6.18	0.0136
Lithium Iodide	2.40	0.0109
Sodium Nitrate	6.95	0.0039
Perchloric Acid	6.89	0.0187
Water alone	0.0	0.0086

SOLUBILITY OF A MIXTURE OF 30 PERCENT HELIUM AND 70 PERCENT NEON IN WATER.

(Valentiner, 1927.)

t°	(Ostwald Solubility Expression)
0	0.021
17	0.015
45	0.010

The author has collected and recalculated all previous determinations of the solubility of the rare gases in water.

SOLUBILITY OF HELIUM IN LIQUID AMMONIA.

(Ipatjew and Teodorowitsch, 1932.)

t°	He Pressure in Atm.	cc He ₂ (at 0° and 760mm) dissolved in 1.0cc NH ₃	t°	He Pressure in Atm.	cc He ₂ (at 0° and 760mm) dissolved in 1.0cc NH ₃
-16	35.5	0.554	+20	23.3	0.465
-10	34.55	0.521	"	38.7	0.719
+20	5.35	0.126	25	37.7	0.750
"	12.6	0.272	29	26.6	0.822

SOLUBILITY OF HELIUM IN SEVERAL ORGANIC SOLVENTS.
(Lannung, 1930.)

The results are expressed in terms of the Bunsen Absorp. Coef. and the Ostwald Solubility Expression (See results for the Solubility of Helium in Water by Lannung, 1930.)

Results for the Solubility in:

t°	Methyl Alcohol		Ethyl Alcohol		Acetone	
	β	1	β	1	β	1
15	0.0298	0.0314	0.0268	0.0283	0.0284	0.0300
18	0.0307	0.0327	0.0275	0.0293	0.0299	0.0319
20	0.0313	0.0336	0.0281	0.0302	0.0309	0.0332
25	0.0328	0.0358	0.0294	0.0321	0.0331	0.0361
30	0.0343	0.0381	0.0306	0.0340	—	—
37	0.0364	0.0413	0.0325	0.0369	—	—

t°	Benzene		Cyclohexane		Cyclohexanol	
	β	1	β	1	β	1
15	0.0165	0.0174	0.0220	0.0232	—	—
18	0.0174	0.0186	0.0227	0.0242	—	—
20	0.0180	0.0193	0.0236	0.0253	—	—
25	0.0192	0.0210	0.0252	0.0275	0.0100	0.0109
30	0.0202	0.0224	0.0268	0.0297	0.0107	0.0119
37	0.0221	0.0251	0.0293	0.0333	0.0119	0.0135

HAFNIUM Oxy BROMIDE HfOBr_2

SOLUBILITY IN AQUEOUS SOLUTIONS OF HYDRO BROMIC ACID AT 25°.
(v. Hevesy and Wagner, 1930.)

d $\frac{25}{4}$ of sat. sol.	Normality of Aq. HBr	Gms. HfO_2 per liter sat. sol.	d $\frac{25}{4}$ of sat. sol.	Normality of Aq. HBr	Gms. HfO_2 per liter sat. sol.
2.0838	0.354	694.5	1.4984	8.77	10.60
1.6989	3.620	314.5	1.7157	13.36	0.80
1.4348	6.568	48.90			

HAFNIUM Acid Oxy FLUORIDE $\text{HfOF}_2 \cdot \text{H}_2\text{F}_2 \cdot 2\text{H}_2\text{O}$.

SOLUBILITY IN AQUEOUS SOLUTIONS OF HYDROFLUORIC ACID AT 25°.
(v. Hevesy and Wagner, 1930.)

d $\frac{25}{4}$ of sat. sol.	Normality of Aq. HBr	Gms. HfO_2 per liter sat. sol.	d $\frac{25}{4}$ of sat. sol.	Normality of Aq. HBr	Gms. HfO_2 per liter sat. sol.
1.577	0.0	413.6	2.050	10.05	903.9
1.537	0.0	475.6	1.899	15.05	733.6
1.650	1.06	568.3	1.902	15.03	741.8
1.655	1.06	571.2	1.394	20.09	250.6
2.036	6.03	892.1	1.404	20.09	258.9
2.040	6.03	897.1			

HAFNIUM Oxy CHLORIDE HfOCl_2 .

SOLUBILITY OF HAFNIUM OXYCHLORIDE IN AQUEOUS SOLUTIONS OF
HYDROCHLORIC ACID AT 20°. (von Hevesy, 1925.)

The hafnium contained 5 per cent Zr O_2 .

Normality aq. HCl.	d of sat. sol.	Gm. mols. HfOCl_2 per liter sat. sol.	Normality aq. HCl.	d of sat. sol.	Gm. mols. HfOCl_2 per liter sat. sol.
5.64	—	0.167	10.56	1.180	0.0801
6.48	1.127	0.103	11.28	—	0.1509
9.02	1.154	0.053	11.40	—	0.0619
10.33	—	0.0668			

HAFNIUM Ammonium FLUORIDES, $\text{Hf}(\text{NH}_4)_2\text{F}_6$ and $\text{Hf}(\text{NH}_4)_3\text{F}_7$.

SOLUBILITY IN WATER AND Aq. NH_4F SOLUTIONS.
(von Hevesy, 1925; von Hevesy, Christiansen and Berglund, 1925.)

Compound.	Solvent.	t°.	Mols. per liter	
			NH_3 .	Hf.
$\text{Hf}(\text{NH}_4)_2\text{F}_6$	Water	0	1.807	0.890
"	"	20	2.832	1.425
$\text{Hf}(\text{NH}_4)_3\text{F}_7$	"	0	1.230	0.425
"	"	20	1.756	0.538
"	0.922 n NH_4F	20	—	0.261
"	1.971 "	20	—	0.108
"	5.01 "	20	—	0.0258
" + $\text{Hf}(\text{NH}_4)_2\text{F}_6$ }	Water	20	3.038	1.439

F

HAFNIUM Potassium FLUORIDE HfK_2F_6 .

One liter of aq. 0.125 n HF solution dissolves 0.1008 mols. HfK_2F_6 at 20°.

" 5.89 " 0.1942 "

(von Hevesy, 1925; von Hevesy, Christia'son and Berglund, 1925.)

HAFNIUM PHOSPHATE $\text{HfO}(\text{H}_2\text{PO}_4)$.

SOLUBILITY OF HAFNIUM PHOSPHATE IN AQUEOUS SOLUTIONS OF
HYDROCHLORIC ACID AT 20°. (von Hevesy and Kimura, 1925.)

About 0.1 gm. of the compound was shaken 3 days in a thermostat and then allowed to stand many days. 100 cc. of the solution filtered through glass wool was evaporated and residue ignited and the weighed.

PO

Normality of aq. HCl.	Wt. of ignited residue from 100 cc. sat. sol.	Gm. mols. compd. per liter.
5.94	0.0031	0.00009
10.21	0.0043	0.00012
10.48	0.0046	0.00013

HYDRARGYRUM (Mercury) Hg.**THE SOLUBILITY OF METALLIC MERCURY IN WATER.**

(Stock, 1934.)

By operating with the greatest possible care to remove air from the water and the Hg, the solubility was found to be

0.02 to 0.03y Hg per cc H_2O at 30° (y = 0.001 mg.)

When the separation of the water from the Hg was made in the air the solubility rose to 0.06y or more per cc H_2O . This increase is due to oxidation. At 85° the solubility was found to be 0.3y and at 100 0.6y Hg per cc H_2O .

Experiments were also made at 30° of the solubility of Hg in H_2O in contact with air, both with and without stirring and in presence of oxygen. In the latter case the solubility rose to 39.6y Hg per cc H_2O in 2 months. Using pure red HgO a solubility of 42.4y HgO per cc H_2O was found. Alkali hydroxide in presence of air increased the Solubility of Hg to 54y in 5% KOH and to 135y in 10% KOH. Many other experiments of a similar character are described.

One liter sat. sol. of Hg_2Br_2 in water contains 0.000039 gm. Hg_2Br_2 at 25°. (Sherrill, 1903.)

From the measured E.M.F. of the chain $\text{Hg} \mid \text{Hg}_2\text{Br}_2 \cdot \text{KBr}, \text{C} \mid \text{KNO}_3$ against $\mid \text{C}, \text{KCl} \cdot \text{Hg}_2\text{Cl}_2 \mid \text{Hg}$; $E = 0.1318 - 0.000188t$, the calculated Solubility Product of Hg_2Br_2 is $0.545 \cdot 10^{-23}$ at 10°, $1.00 \cdot 10^{-23}$ at 14.9°, $3.88 \cdot 10^{-23}$ at 19.2°, $5.5 \cdot 10^{-23}$ at 25° and $6.95 \cdot 10^{-23}$ at 26.5°.

HYDRARGYRUM BROMIDE (Mercuric Bromide) HgBr_2

SOLUBILITY OF MERCURIC BROMIDE IN WATER.

(Tourneux and Pernot, 1925; above 100° Benrath, Qjedebo, Schiffers and Wunderlich, 1937.)

Gms. HgBr_2			Gms. HgBr_2			Gms. HgBr_2		
per 100 gms. sat. sol.			per 100 gms. sat. sol.			per 100 gms. sat. sol.		
t°			t°			t°		
0	0.3 (?)		50	1.25		173	33.5	
10	0.4 (?)		60	1.65		185	59.1	
20	0.55		80	2.7		187	74.7	
25	0.61		100	4.7		189	88.1	
30	0.65		142	12.0		193	92.8	
40	0.9		164	22.4		201	96.2	

EQUILIBRIUM IN THE SYSTEM MERCURIC BROMIDE, AMMONIA, WATER AT 8°-10°. (Gaudechon, 1910.)

The mixtures were shaken intermittently for 21-48 hrs. Both the clear sat. solution and the separated and dried solid phases were analyzed.

Initial Mixture.			Sat. Solution.			Solid Phase.
Gms. Mols. per Liter.			Gms. Atoms. per Liter.			
HgBr ₂ .	NH ₃ .	NH ₄ Br.	Hg.	Br.	N.	
0.0125	0.0250	0	trace	0.0154	0.0185	(NH ₄ Br), HgBr ₂
0.0166	0.0332	0	0.00032	0.0172	0.0202	36% " + 64% NH ₄ Br.NH ₄ Br
0.025	0.050	0	0.00078	0.0241	0.0251	NH ₄ Br.NH ₄ Br
0.050	0.100	0	0.0019	0.0525	0.0514	"
0.0125	0.025	0.0375	0.00178	0.0497	0.0497	"
0.025	0.050	0.075	0.0041	0.103	0.108	"
0.0328	0.0656	0.0984	0.0061	0.133	0.133	93% " + 6% NH ₄ Br. ₃ NH ₄ Br
0.0365	0.073	0.1095	0.0060	0.132	0.133	36% " + 64% NH ₄ Br. ₃ NH ₄ Br
0.050	0.100	0.150	0.007	0.170	0.169	NH ₄ Br. ₃ NH ₄ Br
0.100	0.200	0.300	0.0124	0.333	0.338	"
0.0180	0.036	0.01875	0.001	0.0315	0.0318	NH ₄ Br.NH ₄ Br
0.050	0.100	0.006	0.0057	0.1172	0.1178	"
0.050	0.100	0.150	0.0071	0.169	0.168	NH ₄ Br. ₃ NH ₄ Br
0.100	0.200	0.160	0.0083	0.184	0.187	"
0.125	0.250	0.306	0.0160	0.303	...	"

SOLUBILITY OF MERCURIC BROMIDE IN AQUEOUS SALT SOLUTIONS AT 25°. (Herz and Paul, 1913.)

(The mixtures were constantly agitated for eight days.)

In Aq. BaBr_2 .		In Aq. CaBr_2 .		In Aq. KBr .		In Aq. NaBr .		In Aq. SrBr_2 .	
Mols. per Liter.		Mols. per Liter.		Mols. per Liter.		Mols. per Liter.		Mols. per Liter.	
BaBr_2 .	HgBr_2 .	CaBr_2 .	HgBr_2 .	KBr .	HgBr_2 .	NaBr .	HgBr_2 .	SrBr_2 .	HgBr_2 .
0	0.017	0.072	0.117	0	0.017	0.118	0.078	0.062	0.104
0.274	0.370	0.645	0.676	0.209	0.098	0.596	0.285	0.328	0.471
0.396	0.540	1.892	1.358	0.770	0.472	1.142	0.540	0.668	0.902
0.579	0.759	2.479	2.766	2.380	1.360	2.448	1.276	1.401	1.770
1.096	1.478	3.754	3.666	3.470	1.930	5.246	2.306	1.872	2.238

The following slightly higher results for KBr solutions are given by Sherrill (1903).

Mols. KBr per liter	0	0.05	0.10	0.5	0.866	2	3	4
Mols. HgBr_2 per liter	0.017	0.055	0.088	0.0359	0.611	1.407	2.096	2.339

Data for equilibrium in the system $\text{HgBr}_2 + \text{KOH} + \text{H}_2\text{O}$ at 25° are given by Herz (1910).

**SOLUBILITY OF MERCURIC BROMIDE IN AQUEOUS SOLUTIONS OF POTASSIUM
BROMIDE AND VICE VERSA.**

(Pernot, 1932.)

The original results are presented only in the form of a diagram from which the following approximate figures were read.

Results at 0°			Results at 34°			Results at 80°		
Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase
KBr	Hg Br ₂		KBr	Hg Br ₂		KBr	Hg Br ₂	
0.0	0.3	HgBr ₂	0.0	0.68	HgBr ₂	0.0	2.7	HgBr ₂
7.5	15.0	"	5.0	15.0	"	10.0	30.0	"
12.0	24.0	"	11.0	23.0	"	15.0	50.0	"
20.0	31.5	1.1.1	15.0	38.0	"	18.5	75.0	" + 1.1.1
25.0	37.5	"	19.0	51.0	" + 1.1.1	21.5	70.0	1.1.1
30.0	43.2	"	23.0	48.5	1.1.1	25.0	65.0	"
32.5	48.2	" + KBr	28.0	48.0	"	28.0	63.0	"
32.2	40.0	KBr	33.5	55.0	" + KBr	32.0	62.0	" + KBr
31.8	30.0	"	34.0	45.0	KBr	35.0	50.	KBr
32.5	20.0	"	35.0	30.0	"	40.0	26.	"
34.0	0.0	"	40.0	15.0	"	44.0	15.	"
			42.1	0.0	"	48.7	0.0	"

Br

1.1.1 = HgBr₂.KBr.H₂O

HYDRARGYRUM BROMIDE (ic)

**SOLUBILITY OF MERCURIC BROMIDE IN AQUEOUS SOLUTIONS OF METHYL
ALCOHOL, ETHYL ALCOHOL AND OF ETHYL ACETATE AT 25°.**

(Herz and Anders, 1907.)

In Aq. Methyl Alcohol.			In Aq. Ethyl Alcohol.			In Aq. Ethyl Acetate.		
Wt. % CH ₃ OH in Solvent.	<i>d</i> ₂₅ of Sat. Sol.	Gms. HgBr ₂ per 100 cc. Sat. Sol.	Wt. % C ₂ H ₅ OH in Solvent.	<i>d</i> ₂₅ of Sat. Sol.	Gms. HgBr ₂ per 100 cc. Sat. Sol.	Wt. % CH ₃ CO ₂ C ₂ H ₅ in Solvent.	<i>d</i> ₂₅ of Sat. Sol.	Gms. HgBr ₂ per 100 cc. Sat. Sol.
10.6	0.9857	0.72	0.	1.0022	0.60	0	1.0022	0.60
30.77	0.9588	1.29	20.18	0.9717	0.67	4.39	1.0018	0.574
47.06	0.9401	2.52	40.69	0.9435	1.59	96.76	1.1159	26.69
64	0.9386	6.85	70.01	0.9214	6.58	100	1.0113	14.13
78.05	0.9744	14.66	100	0.9873	22.81			
100	1.2275	50.25						

100 gms. sat. sol. in 95% C₂H₅OH (*d*₁₅ = 0.8126) contain 13.2 gms. HgBr₂ at 0°, 16.53 gms. at 25° and 22.63 gms. at 50°.

(Reinders, 1900.)

SOLUBILITY OF MERCURIC BROMIDE IN ALCOHOLS.

(Timofeiew, 1894.)

In Methyl Alcohol.		In Ethyl Alcohol.		In Propyl Alcohol.		In Isobutyl Alcohol.	
t°.	Gms. HgBr ₂ per 100 Gms. CH ₃ OH.	t°.	Gms. HgBr ₂ per 100 Gms. C ₂ H ₅ OH.	t°.	Gms. HgBr ₂ per 100 Gms. C ₃ H ₇ OH.	t°.	Gms. HgBr ₂ per 100 Gms. C ₄ H ₉ OH.
0	41.15	0	25.2	0	14.6	0	4.61
10	49.5	10	26.3	10	15.6	10	5.63
19	66.3	19	29.7	19	15.5	23	6.65
22	60.9	39	31.9	39	20.8	39	9.58
39	71.3	65	44.5	65	31.3	65	15.80
65	90.8	89	66.9	86.5	42.7		
97	139.1						

MERCURY BROMIDE (ic) HgBr_2 .

SOLUBILITY OF MERCURIC BROMIDE IN WATER AND IN AQUEOUS SOLUTIONS OF GLYCEROL AT 25°. (Moles and Marquina, 1924.)

Solvent.	d_{25}^{25} of sat. sol.	Gms. HgBr_2 per 100 gms. solvent.
Water.....	1.0023	0.6135
Aq. 25.0 % glycerol.....	1.0651	0.9840
» 75.2 »	1.2204	3.456
» 99.2 »	1.4000	15.687

SOLUBILITY OF MERCURIC BROMIDE IN METHYL ALCOHOL AND IN ETHYL ALCOHOL.
(Lloyd, Brown, Glynwyn, Bonnel and Jones, 1928.)

Results for Methyl Alcohol

Results for Ethyl Alcohol

t°	Gms. HgBr_2 per 100 gms. CH_3OH	Solid Phase	t°	Gms. HgBr_2 per 100 gms. $\text{C}_2\text{H}_5\text{OH}$	Solid Phase
10	53.5	$\text{HgBr}_2 \cdot \text{CH}_3\text{OH}$	- 0	27.3	HgBr_2
20	65.3	"	10	28.2	"
22	70.3	"	20	28.6	"
27	71.6	HgBr_2	30	31.6	"
30	72.1	"	40	34.0	"
40	76.0	"	50	36.2	"
50	81.9	"	60	42.3	"
60	85.1	"	70	46.3	"

SOLUBILITY OF MERCURIC BROMIDE IN METHYL ALCOHOL AND IN ETHYL ALCOHOL.
(Malhotra, 1928.)

Except in a few cases the determinations were made by the synthetic method.

Results for Methyl Alcohol

of $d_{25}^{15} = 0.7961 = 99.88 \text{ Wt. \% } \text{CH}_3\text{OH}$

Results for Ethyl Alcohol

of 87.73 Wt. % $\text{C}_2\text{H}_5\text{OH}$

t°	Gms. HgBr_2 per 100 gms. CH_3OH	t°	Gms. HgBr_2 per 100 gms. solvent
22.1	67.62	32.9	17.22
27.4	68.81	42.13	21.44
30.8	70.25	45.20	22.91
36.1	73.31	49.07	25.35
49.8	84.43	55.85	28.61
		61.60	31.84
		68.97	37.11

Results for Ethyl Alcohol
of $d_{25}^{15} = 0.7943 = 99.78 \text{ Wt. \% } \text{C}_2\text{H}_5\text{OH}$

t°	Gms. HgBr_2 per 100 gms. $\text{C}_2\text{H}_5\text{OH}$	t°	Gms. HgBr_2 per 100 gms. $\text{C}_2\text{H}_5\text{OH}$
0.0	24.04	44.80	34.55
16.15	26.25	48.60	35.87
24.95	28.40	53.20	37.80
29.15	29.28	58.00	39.80
31.35	30.05	60.15	40.63
34.30	31.29	64.80	43.10
41.60	33.53	79.25	60.15

SOLUBILITY OF MERCURIC BROMIDE IN MIXTURES OF ALCOHOLS AT 25°.
(Herz and Kuhn, 1908.)

In Mixtures of Methyl and Ethyl Alcohols.			In Mixtures of Methyl and Propyl Alcohols.			In Mixtures of Ethyl and Propyl Alcohols.		
% CH ₃ OH in Mixture.	d_{25}^0 of Sat. Sol.	Gms. HgBr ₂ per 100 cc. Sat. Sol.	% C ₃ H ₇ OH in Mixture.	d_{25}^0 of Sat. Sol.	Gms. HgBr ₂ per 100 cc. Sat. Sol.	% C ₃ H ₇ OH in Mixture.	d_{25}^0 of Sat. Sol.	Gms. HgBr ₂ per 100 cc. Sat. Sol.
0	0.9873	22.8	0	1.227	50.20	0	0.9873	22.80
4.37	0.9932	23.1	11.11	1.1954	47.28	8.1	0.9802	22.25
10.4	1.009	25.4	23.8	1.1524	41.53	17.85	0.9740	21.06
41.02	1.080	33.3	65.2	1.0257	25.30	56.6	0.9487	17.63
80.69	1.185	45.7	91.8	0.9437	16.35	88.6	0.9269	14.76
84.77	1.193	46.8	93.75	0.9368	15.86	91.2	0.9239	14.64
91.25	1.211	48.6	96.6	0.9275	14.66	95.2	0.9227	14.06
100	1.227	50.2	100	0.9213	13.78	100	0.9213	13.78

SOLUBILITY OF MIXTURES OF MERCURIC BROMIDE AND MERCURIC CHLORIDE IN ALCOHOL AT 25°.

(Van Pelt, Jr., and de Boer, 1934.)

Gms. per 100 gms. sat. sol.		Percent HgBr ₂ in Solid Phase	Gms. per 100 gms. sat. sol.		Percent HgBr ₂ in Solid Phase
HgCl ₂	HgBr ₂		HgCl ₂	HgBr ₂	
31.35	0.0	—	17.4	20.5	50
31.0	3.3	—	14.0	22.4	60
27.3	7.1	14	10.7	21.8	—
25.8	9.8	27	10.4	22.1	—
26.0	10.0	—	6.7	24.6	100
24.0	12.2	—	3.8	20.2	100
22.2	14.1	41	0.0	18.1	—

The solid phase consists of a series of mixed crystals up to about 70 percent HgBr₂.

SOLUBILITY OF MERCURIC BROMIDE IN ETHYL ALCOHOL SOLUTIONS OF POTASSIUM BROMIDE AT 34° AND VICE VERSA.

(Pernot, 1933.)

The original results are given only in the form of diagrams from which the following approximate figures have been read.

Results for Absolute C₂H₅OH

Results for 95 Percent C₂H₅OH

Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase
HgBr ₂	KBr		HgBr ₂	KBr	
25.0	0.0	HgBr ₂	19.0	0.0	HgBr ₂
35.0	3.0	"	30.0	3.0	"
40.0	4.5	"	40.0	6.0	"
45.0	6.0	" + 1.1.A	45.5	7.2	" + 1.1.H
40.0	6.0	1.1.A	35.0	7.2	1.1.H
25.0	6.0	"	30.0	7.5	"
20	6.0	"	25.5	8.5	"
20	7.0	" + KBr	28.0	12.0	"
15	5.5	KBr	30.5	14.5	" + KBr
10	4.0	"	20.5	10.0	KBr
5	2.0	"	10.0	5.0	"

1.1.A = HgBr₂.KBr.C₂H₅OH

1.1.H = HgBr₂.KBr.H₂O

SOLUBILITY OF MERCURIC BROMIDE IN AN EQUIMOLECULAR MIXTURE OF ETHYL ALCOHOL AND BENZENE. (Dukelski, 1907.)

t°.	0.	10.	20.	30.	40.	50.	60.
Gms. HgBr ₂ per 100 Gms. Sat. Sol.	10.7	12	14	16	17.5	19	21
100 gms. of sat. sol. in acetone at 25° contain 34.76 gms. HgBr ₂ . (Reinders, 1900.)							

SOLUBILITY OF MERCURIC BROMIDE IN ANILINE. (Staronka, 1910.)

t°.	Mol. % HgBr ₂ .	Gms. HgBr ₂ per 100 Gms. C ₆ H ₅ NH ₂ .	Solid Phase.	t°.	Mol. % HgBr ₂ .	Gms. HgBr ₂ per 100 Gms. C ₆ H ₅ NH ₂ .	Solid Phase.
60	4	16.14	HgBr ₂ ·2C ₆ H ₅ NH ₂	110*	33.3	193.3	HgBr ₂ ·2C ₆ H ₅ NH ₂
70	5.8	23.83	"	109.7†	33.5	195	" + HgBr ₂ ·C ₆ H ₅ NH ₂
80	8.3	35.04	"	115	37.2	229.3	HgBr ₂ ·C ₆ H ₅ NH ₂
90	12.2	53.80	"	120	42.3	283.8	"
100	18.8	89.64	"	124	50	387.2	"
105	23.2	116.9	"	123	55.4	480.9	"

* M. pt.

† Eutec.

100 gms. ethyl acetate dissolve 13.05 gms. HgBr₂ at 18°. (Naumann, 1910.)

100 gms. methyl acetate dissolve 21.93 gms. HgBr₂ at 18° (d₁₈ sat. sol. = 1.090). (Naumann, 1909.)

SOLUBILITY OF MERCURIC BROMIDE IN ANHYDROUS ACETIC ACID DETERMINED BY THE SYNTHETIC METHOD.

(Davidson and Chappell, 1938.)

t°	Mols. HgBr ₂ per 100 mols. HgBr ₂ + CH ₃ COOH	Solid Phase	t°	Mols. HgBr ₂ per 100 mols. HgBr ₂ + CH ₃ COOH	Solid Phase
16.5	0.194	CH ₃ COOH	75	0.707	HgBr ₂
25	0.261	HgBr ₂	86	0.860	"
32	0.287	"	92	0.998	"
41	0.350	"	97	1.13	"
51	0.413	"	103	1.29	"
58	0.477	"	110	1.50	"
71	0.650	"			

SOLUBILITY OF MERCURIC BROMIDE IN PYRIDINE. (Staronka, 1910.)

t°.	Mol. % HgBr ₂ .	Gms. HgBr ₂ per 100 Gms. C ₅ H ₅ N.	Solid Phase.	t°.	Mol. % HgBr ₂ .	Gms. HgBr ₂ per 100 Gms. C ₅ H ₅ N.	Solid Phase.
10	5	24	HgBr ₂ ·2C ₅ H ₅ N	107*	39	291.5	HgBr ₂ ·2C ₅ H ₅ N + HgBr ₂ ·C ₅ H ₅ N
30	8	39.64	"	110	40.4	309	HgBr ₂ ·C ₅ H ₅ N
50	11.2	57.49	"	120	45.5	381.3	"
80	17.5	96.68	"	123†	50	455.8	"
100	22	128.5	"	125	51	474.4	3HgBr ₂ ·2C ₅ H ₅ N
110	24.5	147.8	"	130	54.2	539.4	"
118†	33.3	227.6	"	134†	60	683.7	"
110	35.5	250.8	"	133	64	810.4	"

* Eutec.

† m. pt.

SOLUBILITY OF MERCURIC BROMIDE IN QUINOLINE. (Staronka, 1910.)

t°.	Mol. % HgBr ₂ .	Gms. HgBr ₂ per 100 Gms. C ₈ H ₇ N.	Solid Phase.
88	4.4	12.85	HgBr ₂ ·2C ₈ H ₇ N
111	8.9	27.28	"
127	14.3	46.58	"
134	17.6	61.16	"

Data for the solubility of mercuric bromide in nitrobenzene, in *p* nitrotoluene, in *m* nitrotoluene, in *o* nitrotoluene and in α nitronaphthalene, determined by the method of lowering of the freezing-point, are given by Mascarelli, 1906, and Mascarelli and Ascoli, 1907. Data for HgBr₂ + Se are given by Olivari, 1912.

DISTRIBUTION OF MERCURIC BROMIDE BETWEEN WATER AND BENZENE
(THIOPHENE FREE) AT 25°. (Sherrill, 1903.)

Mols. per Liter.		Dist. Coef.	Mols. per Liter.		Dist. Coef.
H ₂ O Layer.	C ₆ H ₆ Layer.		H ₂ O Layer.	C ₆ H ₆ Layer.	
0.017	0.194	0.876	0.00634	0.0715	0.89
0.01147	0.1303	0.88	0.00394	0.0436	0.90
0.00953	0.1074	0.89	0.00320	0.0353	0.90

Data are also given for the distribution between aqueous potassium iodide solutions and thiophene free benzene at 25°.

Data for the solubility of mix crystals of HgBr₂ + HgI₂ in acetone at 25° and in ethyl alcohol of $d_{45} = 0.8126 = 95\%$ at 0°, 25° and 50° are given by Reinders (1900). In the case of acetone, the ratio of HgBr₂ in the solution increases with increase of per cent of HgBr₂ in the solid phase. In the case of the alcohol solutions the ratio in solution does not show such regular variations with change of per cent of MgBr₂ in the solid phase.

SOLUBILITY OF MERCURIC BROMIDE IN ORGANIC SOLVENTS.

In Carbon Disulfide.

(Arctowski, 1894.)

In Other Solvents at 18°-20°.

(Sulc, 1900.)

t°.	Gms. HgBr ₂ per 100 Gms. Solution.	t°.	Gms. HgBr ₂ per 100 Gms. Solution.	Solvent.	Formula.	Gms. HgBr ₂ per 100 Gms. Solvent.
-10	0.049	15	0.140	Chloroform	CHCl ₃	0.126
-5	0.068	20	0.187	Bromoform	CHBr ₃	0.679
0	0.087	25	0.232	Carbon Tetrachloride	CCl ₄	0.003
+5	0.105	30	0.274	Ethyl Bromide	C ₂ H ₅ Br	2.31
10	0.122			Ethylene Dibromide	C ₂ H ₄ Br ₂	2.34

One liter benzene dissolves 6.99 gms. HgBr₂ at 25°. (Abegg and Sherrill, 1903.)

100 gms. sat. solution of Mercuric Bromide in Acetone contain 33.9 gms. HgBr₂ at 25°. (Zapata y Zapata, 1930.)

100 gms. of liquid Sulfur Dioxide dissolve 0.074 gm. HgBr₂ at 0°. (Jander and Ruppolt, 1937.)

Fusion-point data have been determined for the following mixtures:

HgBr ₂ + HgCl ₂	(Losana, 1926.)
" + HgI ₂	" "
" + " + HgCl ₂	" "
" + HgSO ₄	(Paic, 1930, 1933.)
" + AgNO ₃	(Bergman, 1922-24, 1926; Bergman, Genke and Isaikin, 1922-24.)
" + TiNO ₃	" "
" + TiSO ₄	(Woskresenskaja, 1929.)
" + PbBr ₂	(Sandonnini, 1912, 1924.)

MERCURY BROMATE (ic) normal Hg(BrO₃)₂, basic HgOHBrO₃.

SOLUBILITY OF EACH IN AQUEOUS SOLUTIONS OF PERCHLORIC ACID AND OF
NITRIC ACID AT 25°. (Smith, 1924.)

Results for Hg(BrO₃)₂ in Aq:
Perchloric Acid. Nitric Acid.

Approx. Normality of HClO ₄ .	Gms. Hg(BrO ₃) ₂ per 100 cc. sat. sol.	Approx. Normality of HNO ₃ .	Gms. Hg(BrO ₃) ₂ per 100 cc. sat. sol.
2.0	6.58		14.66
2.5	5.22	3.0	15.00
3.0	4.13	4.0	14.99
3.5	3.40	5.0	14.75
4.0	2.58		
5.0	1.55		

Results for HgOHBrO₃ in Aq:
Perchloric Acid. Nitric Acid.

Approx. Normality of HClO ₄ .	Gms. HgOHBrO ₃ per 100 cc. sat. sol.	Approx. Normality of HNO ₃ .	Gms. HgOHBrO ₃ per 100 cc. sat. sol.
0.0 (=H ₂ O)	0.081	1.0	12.52
1.0	4.34	2.0	21.30
2.0	5.94		
2.5	6.06		
3.0	6.06		

Br

BrO

Hg HYDRARGYRUM

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MERCURY ACETATE (ous) $\text{Hg}_2(\text{CH}_3\text{COO})_2$.

SOLUBILITY OF MERCUROS ACETATE IN WATER AND IN AQUEOUS ACETIC ACID AT 21°. (Legerlotz, 1918.)

Recrystallized mercurous acetate was rubbed with water or aqueous acetic acid untill thoroughly wet and the mixture constantly shaken in a thermostat for 120 hours. The saturated solution was analyzed by adding a slight excess of Na Cl to precipitate Hg Cl and this latter filtered, dried and weighed.

Solvent.	Gms. $\text{Hg}_2(\text{CH}_3\text{COO})_2$ per 100 cc. sat. sol.
Water.....	0.1024
Aq. acetic acid (conc. = 2).....	0.0730
" (conc. = 4).....	0.0690
" (conc. = 6).....	0.0650

The amount of acetic acid corresponding to conc. 2, 4 and 6 is not stated.

100 gms. sat. solution of Mercurous Acetate in Water contain 0.75 gm. $\text{Hg}_2(\text{CH}_3\text{COO})_2$ at 13°. (Welsh and Broderson, 1915.)

The Solubility Product of $\text{Hg}_2(\text{CH}_3\text{COO})_2$ in Water at 25° is 2.0×10^{-15} (Bargarsky 1897, reported by Brodsky, 1929.)

100cc anhydrous Hydrazine dissolve about 2.0 gms. $\text{Hg}_2(\text{CH}_3\text{COO})_2$ at about 20° with precipitation of Hg. (Welsh and Broderson, 1915.)

100 gms. Methyl Alcohol dissolve 1.24 gm. $\text{Hg}_2(\text{CH}_3\text{COO})_2$ at 15° and 1.40 gm. at the b. pt. (66.3°). (Henstock, 1934.)

CH HYDRARGYRUM ACETATE (Mercuric Acetate) $\text{Hg}(\text{CH}_3\text{COO})_2$

100 gms. water dissolve 25 gms. $\text{Hg}(\text{CH}_3\text{COO})_2$ at 10°. (Welsh and Broderson, 1915.)

100 gms. Methyl Alcohol dissolve 7.54 gms. $\text{Hg}(\text{CH}_3\text{COO})_2$ at 15° and 49.84 gms. at the b. pt. (66.7°). (Henstock, 1934.)

100 gms. Acetone dissolve 0.60 gm. $\text{Hg}(\text{CH}_3\text{COO})_2$ at 15°. (Henstock, 1934.)

100 gms. of liquid Sulfur Dioxide dissolve 0.095 gm. $\text{Hg}(\text{CH}_3\text{COO})_2$ at 0°. (Jander and Ruppolt, 1937.)

SOLUBILITY OF MERCURIC ACETATE IN MIXTURES OF PHENOL AND ACETIC ACID AT 15°. (Mameli and Cocconi, 1922.)

Gms. per 100 gms. sat. sol.			Gms. per 100 gms. sat. sol.		
$\text{Hg}(\text{CH}_3\text{COO})_2$.	$\text{C}_6\text{H}_5\text{OH}$.	CH_3COOH .	$\text{Hg}(\text{CH}_3\text{COO})_2$.	$\text{C}_6\text{H}_5\text{OH}$.	CH_3COOH .
34.03	51.93	14.04	35.46	52.82	11.72
40.08	51.90	8.02	8.61	18.65	72.74
7.40	8.40	84.20	9.23	34.99	55.78
42.02	52.20	5.78	13.56	43.76	42.68
9.65	19.46	70.89	28.53	50.76	20.71

Data for the f. pt. of $\text{Hg}(\text{CH}_3\text{COO})_2 + \text{C}_6\text{H}_5\text{OH}$ and other mixtures are also given by Mameli and Cocconi.

MERCUROS TARTRATE $\text{Hg}_2\text{C}_4\text{H}_4\text{O}_6$

The Solubility Product of Mercurous Tartrate in Water at 18°, as quoted from Behrend, 1894, by Brodsky, 1929, is $(2) \cdot 10^{-10}$.

MERCURY Nitroso PHENYL Hydroxylamine $\text{Hg}[\text{C}_6\text{H}_5\text{N}(\text{NO})\text{O}]_2$.

This compound is prepared by precipitating in acid solutions, salts of mercury with "Cupferron" (the ammonium salt of nitroso phenyl hydroxylamine). Its solubility in water at 18° is less than 1.3×10^{-6} gm. atoms or 0.3 mg per liter. (Pinkus and Martin, 1927.)

MERCURY BENZOATE (ic) $\text{Hg}(\text{C}_6\text{H}_5\text{COO})_2 \cdot \text{H}_2\text{O}$.

100 cc. of sat. sol. of mercuric benzoate in water contain 0.209 gm. $\text{Hg}(\text{C}_6\text{H}_5\text{COO})_2$ at 20°. (Ephraim and Pfister, 1925.)

100 gms. H_2O dissolve 1.2 gm. $\text{Hg}(\text{C}_6\text{H}_5\text{COO})_2$ at 15° and 2.5 gms. at 100°. (Tarugi and Checchi, 1901.)

100 gms. Methyl Alcohol dissolve 3.67 gms. $\text{Hg}(\text{C}_6\text{H}_5\text{COO})_2$ at 15° and 3.67 at the b. pt. (66.5°). 100 gms. Acetone dissolve 7.23 gms. $\text{Hg}(\text{C}_6\text{H}_5\text{COO})_2$ at 15°. (Henstock, 1934.)

100 gms. Benzene (C_6H_6) dissolve 2.49 gms. $\text{Hg}(\text{C}_6\text{H}_5\text{COO})_2$ at 15°. (Henstock, 1934.)

MERCURY CINNAMATE (ic) $(\text{C}_6\text{H}_5\text{CH}.\text{CHCOO})_2\text{Hg} \cdot \text{H}_2\text{O}$.

100 gms. H_2O dissolve about 0.03 gm. mercuric cinnamate at 25°. (De Jong, 1906.)
100 gms. H_2O dissolve about 0.53 gm. Hg cinnamate at 100°. (Tarugi & Checchi, 1901.)

MERCURY DIPHENYL $\text{Hg}(\text{C}_6\text{H}_5)_2$.

Fusion-point data for mixtures of $\text{Hg}(\text{C}_6\text{H}_5)_2 + \text{Sn}(\text{C}_6\text{H}_5)_4$ and for $\text{Hg}(\text{C}_6\text{H}_5)_2 + \text{Sb}(\text{C}_6\text{H}_5)_3$ are given by Cambi, 1912.

CN

MERCURIC DIAZOAMINO BENZENE $\text{Hg}(\text{C}_6\text{H}_5\text{N} = \text{N}-\text{C}_6\text{H}_5)_2$.**SOLUBILITY IN ALCOHOLS.**

(Watt and Fernellus, 1935.)

Alcohol	t°	Gms. $\text{Hg}(\text{C}_6\text{H}_5\text{N} = \text{N}-\text{C}_6\text{H}_5)_2$ per liter sat. sol.
Methyl Alcohol	25	0.0116
Ethyl Alcohol	25	0.0052
n Propyl Alcohol	25	0.0228

MERCURIC CAMPHOR CARBONATE $\text{Hg}(\text{C}_{10}\text{H}_{15}\text{O}.\text{CO}_2)_2$ **SOLUBILITY IN SEVERAL SOLVENTS.**

(Picon, 1931.)

This compound is made by allowing camphoric acid and yellow oxide of mercury to react in the cold in presence of a small amount of water.

Solvent	t°	Gms. $\text{Hg}(\text{C}_{10}\text{H}_{15}\text{O}.\text{CO}_2)_2$ per liter sat. sol.
Methyl Alcohol	15	44.9
Ethyl Alcohol	10	46.0
Ethyl Ether	10	133.0
Acetone	12.5	84.7
Ethyl Acetate	12.5	82.6
Chloroform	12.5	376.2
Carbon Tetrachloride	12.5	215.9
Benzene	15.0	560.3
Carbon Disulfide	15	341.25
Petroleum Ether	10	43.4
Gasoline	10	145.2
Oil	15	50.0

Hg HYDRARGYRUM

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HYDRARGYRUM (Mercuric Palmitate and Stearate)

SOLUBILITY OF EACH SEPARATELY IN SEVERAL SOLVENTS AT 20°.
(Dietzel and Sedlmeyer, 1928.)

Weighed amounts of compound and solvent were shaken for 30 hours. The mixture was filtered and the excess of undissolved compound weighed and the amount dissolved found by difference.

Results for Hg Palmitate $\text{Hg}(\text{C}_{16}\text{H}_{31}\text{O}_2)_2$		Results for Hg Stearate $\text{Hg}(\text{C}_{18}\text{H}_{35}\text{O}_2)_2$	
Solvent	Gm. Mols. $\text{Hg}(\text{C}_{16}\text{H}_{31}\text{O}_2)_2$ per liter sat. sol.	Solvent	Gm. Mols. $\text{Hg}(\text{C}_{18}\text{H}_{35}\text{O}_2)_2$ per liter sat. sol.
Abs. Ethyl Alcohol	0.0005404	Abs. Ethyl Alcohol	0.0006809
Ethyl Ether	0.0005460	Ethyl Ether	0.0005061
Chloroform	0.0007627	Chloroform	0.0007279
Mixture of Alcohol		Mixture of Alcohol	
Chloroform & Pyridine	0.01261	Chloroform & Pyridine	0.001380

MERCURY FULMINATE $\text{C}_2\text{HgN}_2\text{O}_2$

One liter of solution in water contains 0.70 gm. $\text{C}_2\text{HgN}_2\text{O}_2$ at 12° and 1.76 gms. at 49°.
(Holleman, 1896)

CN MERCURIC CYANIDE $\text{Hg}(\text{CN})_2$ **SOLUBILITY IN WATER.**

t°.	Gms. $\text{Hg}(\text{CN})_2$ per 100:		Authority.
	Gms. H_2O .	cc. Sat. Sol.	
- 0.45 Eutec. about 11		...	(Guthrie, 1878.)
13.5	9.3	...	(Timofeiew, 1894.)
15	12.5	...	(Marsh and Struthers, 1905.)
20	...	9.3	(Konowalow, 1898, 1899.)
25	...	11.12	(Sherrill, 1903.)
25	11.27	10.95 ($d_{25} = 1.0813$)	(Herz and Anders, 1907.)
101.1	53.85	...	(Griffiths.)

The Solubility Product of Mercuric Cyanide in Water at 25° is 5.0×10^{-40} as calculated from the results of Immerwahr by Brodsky, 1929. The following results for the Solubility of Mercuric Cyanide in Water at temperatures above 100° are given by Benrath, Gjeddebo, Schliffers and Wunderlich, 1937.

t°	108°	125°	140°	156°	175°	209°
Gms. $\text{Hg}(\text{CN})_2$ per 100 gms. sat. sol.	35.8	42.9	49.8	56.7	63.4	72.8

SOLUBILITY OF MERCURIC CYANIDE IN AQUEOUS POTASSIUM CYANIDE SOLUTIONS AT 25°. (Sherrill, 1903.)

Mols per Liter.		Gms. per Liter.	
KCN.	Hg(CN) ₂ .	KCN.	Hg(CN) ₂ .
0.0493	0.4855	3.21	122.6
0.0985	0.5350	6.41	135.2
0.1970	0.6270	12.83	158.4

The regularity of the increase in solubility proves that the complex Hg(CN)₂. KCN is formed at the given concentrations.

Data are also given for the distribution of Hg(CN)₂ between aqueous solutions of KCN and ether at 25°.

HYDRARGYRUM CYANIDE (Mercuric Cyanide)

* SOLUBILITY OF MERCURIC CYANIDE IN AQUEOUS SOLUTIONS OF POTASSIUM CYANIDE AT 25° AND VICE VERSA.
(Corbet, 1926.)

Due to the difficulty of preparing KCN free from KOH the saturated solutions were prepared from double salts which were free of KOH. The solutions were kept in contact with an atmosphere of coal gas previously washed by being passed through solutions of lead acetate and NaOH.

Gms. per 100 gms. sat. sol.		Solid Phase.	Gms. per 100 gms. sat. sol.		Solid Phase.
KCN.	Hg(CN) ₂ .		KCN.	Hg(CN) ₂ .	
41.7	0.00	KCN	12.81	39.96	K ₂ Hg(CN) ₄
39.7	0.49	KCN + K ₂ Hg(CN) ₄	11.37	41.85	Hg(CN) ₂
29.47	2.34	K ₂ Hg(CN) ₄	3.97	20.34	»
17.34	11.09	»	*1.09	13.53	»
14.54	15.54	»	*0.56	11.83	»
12.54	20.65	»	*0.28	10.89	»
12.51	31.19	»	*0.00	10.00	»

*Sherrill, *Z. Physik Chem.*, 43, 719, 1903.

MERCURY CYANIDE (ic) Hg(CN)₂.

SOLUBILITY OF MERCURIC CYANIDE IN AQUEOUS SOLUTIONS OF AMMONIA AT 0°. (Brinkley, 1922).

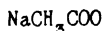
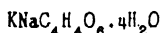
Gms. per 100 gms. sat. sol.		Solid Phase.	Gms. per 100 gms. sat. sol.		Solid Phase.
Hg(CN) ₂ .	NH ₃ .		Hg(CN) ₂ .	NH ₃ .	
6.31	0.0	Hg(CN) ₂	24.68	9.40	Hg(CN) ₂ .NH ₃
8.46	0.43	»	25.41	9.55	» + Hg(CN) ₂ .2NH ₃
11.66	1.09	» + Hg(CN) ₂ .NH ₃	24.04	11.23	Hg(CN) ₂ .2NH ₃
9.40	2.06	Hg(CN) ₂ .NH ₃	23.40	12.59	»
10.32	4.08	»	24.46	16.87	»
15.43	6.82	»	43.57	22.09	»
17.51	7.67	»	66.10	21.51	»
19.31	8.25	»	79.30	20.70	»

One liter 5.2% aqueous NH₃ solution dissolves 204.3 gms. Hg(CN)₂ at about 20°. (Konowalow, 1898.)

SOLUBILITY OF MERCURIC CYANIDE IN AQUEOUS SOLUTIONS OF
POTASSIUM SODIUM TARTRATE AND OF SODIUM ACETATE AT 18-20°.

(Bordelana, 1933.)

In aqueous solutions of:



Gms. per 100 gms. sat. sol.	
$\text{KNaC}_4\text{H}_4\text{O}_6$	$\text{Hg}(\text{CN})_2$
7.5	9.65
10.0	9.69
15.0	10.38
20.0	10.73

Gms. per 100 gms. sat. sol.	
NaCH_3COO	$\text{Hg}(\text{CN})_2$
8.84	9.11
16.57	9.40
32.52	9.69

SOLUBILITY OF MERCURIC CYANIDE IN AQUEOUS SOLUTIONS OF METHYL ALCOHOL,
ETHYL ALCOHOL AND OF ETHYL ACETATE AT 25° (Herz and Anders, 1907.)

CN	In Aq. Methyl Alcohol.			In Aq. Ethyl Alcohol.			In Aq. Ethyl Acetate.		
	Wt. % CH_3OH in Solvent.	d_{25}^{A} of Sat. Sol.	Gms. $\text{Hg}(\text{CN})_2$ per 100 cc. Sat. Sol.	Wt. % $\text{C}_2\text{H}_5\text{OH}$ in Solvent.	d_{25}^{A} of Sat. Sol.	Gms. $\text{Hg}(\text{CN})_2$ per 100 cc. Sat. Sol.	Wt. % $\text{CH}_3\text{COOC}_2\text{H}_5$ in Solvent.	d_{25}^{A} of Sat. Sol.	Gms. $\text{Hg}(\text{CN})_2$ per 100 cc. Sat. Sol.
	10.6	1.0640	11.02	0	1.0813	10.95	0	1.0810	10.95
	30.77	1.0484	12.46	20.18	1.0339	8.76	4.39	1.0798	10.83
	47.06	1.0426	16.37	40.69	1.0006	9.02	96.76	1.9374	2.66
	64	1.0441	20.48	70.01	0.9419	9.57	100	0.9097	1.80
	78.05	1.0484	24.58	100	0.8552	8.19			
	100	1.0762	34.29						

SOLUBILITY OF MERCURIC CYANIDE IN ETHYL ALCOHOL, METHYL ALCOHOL
AND IN MIXTURES OF THE TWO.

In Ethyl Alcohol.			In Methyl Alcohol.		In $\text{CH}_3\text{OH} + \text{C}_2\text{H}_5\text{OH}$ at 25°.		
(Timofciew, '94; de Bruyn, '92; Herz and Kuhn, 1908.)			(Dukelski, 1907.)		(Herz and Kuhn, 1908.)		
t°.	Gms. $\text{Hg}(\text{CN})_2$ per 100 Gms. Sat. Sol.		t°.	Gms. $\text{Hg}(\text{CN})_2$ per 100 Gms. Sat. Sol.	% CH_3OH in Mixture.	d_{25}^{A} of Sat. Sol.	Gms. $\text{Hg}(\text{CN})_2$ per 100 cc. Sat. Sol.
0	8.3		0	26.10	4.37	0.8618	9.02
10	8.8		14.17	29.17	10.4	0.8707	10.10
20	9.25		23.4	32.01	41.02	0.9267	16.70
25	9.53*		27.4	31.77	80.60	1.024	28.20
30	9.8		31.7	32.53	84.77	1.034	29.60
40	10.3		38.1	33.29	91.25	1.052	30
	* $d_{25}^{\text{A}} = 0.8552$		44.5	34.05	100	1.076	34.30

100 gms. of a sat. solution of $\text{Hg}(\text{CN})_2$ in a mixture of equimolecular amounts
of CH_3OH and $\text{C}_2\text{H}_5\text{OH}$ contain 10.2 gms. $\text{Hg}(\text{CN})_2$ at 10°, 13 gms. at 30° and 15
gms. at 50°. (Dukelski, 1907.)

100 gms. Methyl Alcohol dissolve 34.55 gms. $\text{Hg}(\text{CN})_2$ at 15° and
59.84 gms. at the b. pt. (67°).

100 gms. Acetone dissolve 10.3 gms. $\text{Hg}(\text{CN})_2$ at 15°. (Henstock,
1934.)

SOLUBILITY OF MERCURIC CYANIDE IN MIXTURES OF PROPYL AND METHYL ALCOHOLS AND PROPYL AND ETHYL ALCOHOLS AT 25°. (Herz and Kuhn, 1908.)

In C ₃ H ₇ OH+CH ₃ OH.				In C ₃ H ₇ OH+C ₂ H ₅ OH.			
% C ₃ H ₇ OH in Mixed Solvent.	d ₂₅ of Solvent.	d ₂₅ of Sat. Sol.	Gms. Hg(CN) ₂ per 100 cc. Sat. Sol.	% C ₃ H ₇ OH in Mixed Solvent.	d ₂₅ of Solvent.	d ₂₅ of Sat. Sol.	Gms. Hg(CN) ₂ per 100 cc. Sat. Sol.
0	0.7878	1.0760	34.3	0	0.7867	0.8552	8.91
11.11	0.7804	1.0327	29.52	8.1	0.7886	0.8549	7.90
23.80	0.7907	0.9891	24.48	17.85	0.7902	0.8527	7.30
65.20	0.7954	0.8800	10.48	56.6	0.7926	0.8386	5.21
91.80	0.7992	0.8376	5.04	88.6	0.7973	0.8311	3.87
93.75	0.7995	0.8335	4.23	91.2	0.7979	0.8306	3.84
96.60	0.7999	0.8322	3.98	95.2	0.7986	0.8293	3.64
100	0.8004	0.8283	3.44	100	0.8004	0.8283	3.44

100 gms. propyl alcohol dissolve 3.79 gms. Hg(CN)₂ at 13.5°. (Timofeiew, 1894.)

100 gms. 'acetonitrile' (b. pt. 81.6°) dissolve 9.58 gms. Hg(CN)₂ at 18°. (Naumann and Schier, 1914.)

100 gms. benzonitrile' (b. pt. 190-1°) dissolve 1.093 gms. Hg(CN)₂ at 18°. (Naumann, 1914.)

SOLUBILITY OF MERCURIC CYANIDE IN ANILINE. (Staronka, 1910.)

t° of Solidification	41°	49	58.5	65	77	83.5	84	88.5
Mol. % Hg(CN) ₂ in sat. Solution	3.7	5.7	7.7	9	14.2	18.2	19.7	23.4

The solid phases are the unstable Hg(CN)₂·4C₆H₅NH₂ and the stable Hg(CN)₂·2C₆H₅NH₂ (m. pt. about 90°).

One liter sat. solution in ethyl ether contains 2.53 gms. Hg(CN)₂ at 25°. (Abegg and Sherrill, 1903.)

100 gms. glycerol dissolve 27 gms. Hg(CN)₂ at 15.5°.

CN

SOLUBILITIES OF MERCURIC CYANIDE DOUBLE SALTS IN WATER AND IN ALCOHOL.

Double Salt.	t°.	Gms. per 100 Grams.		Observer.
		Water.	Alcohol.	
Hg(CN) ₂ ·2KCN	cold	22.7	...	(Frommuller — Ber. 11, 92, '78.)
Hg(CN) ₂ ·2TiCN	1°	12.6	...	
Hg(CN) ₂ ·2TiCN	10°	9.7	...	"
2Hg(CN) ₂ ·CaBr ₂ ·5H ₂ O	cold	100.0	50.0	(Custer.)
2Hg(CN) ₂ ·CaBr ₂ ·5H ₂ O	boiling	400.0	100.0	"
Hg(CN) ₂ ·KCl·H ₂ O	18°	14.81	...	(Brett.)
Hg(CN) ₂ ·KBr·2H ₂ O	18°	7.49	...	"
Hg(CN) ₂ ·KBr·2H ₂ O	boiling	100.0+	...	"
Hg(CN) ₂ ·BaI ₂ ·4H ₂ O	cold	6.42	4.42	(Custer.)
Hg(CN) ₂ ·BaI ₂ ·4H ₂ O	boiling	250.0	62.5 (90% Alc.)	"
Hg(CN) ₂ ·KI	cold	6.2	1.04 (34° B Alc.)	(Caillot.)
Hg(CN) ₂ ·NaI·2H ₂ O	18°	22.2	15.4 (90% Alc.)	(Custer.)
Hg(CN) ₂ ·SrI ₂ ·6H ₂ O	18°	14.3	25.0 (90% Alc.)	"

SOLUBILITY OF MERCURIC CYANIDE IN ORGANIC SOLVENTS AT 18°-20°. (Sulc, 1900)

Solvent.	Formula.	G. Hg(CN) ₂ per 100 Gms. Solvent.
Bromoform	CHBr ₃	0.005
Carbon Tetra Chloride	CCl ₄	0.001
Ethyl Bromide	C ₂ H ₅ Br	0.013
Ethylene Di Bromide	C ₂ H ₄ Br ₂	0.001

Data for the ternary system, mercuric cyanide, phenol, water are given by Timmermans, 1907.

Hg HYDRARGYRUM

SOLUBILITY OF MERCURIC CYANIDE IN PYRIDINE. (Staronka, 1910.)

Mols. Hg(CN) ₂ t°. per 100 Mols. Solid Phase. Hg(CN) ₂ + C ₅ H ₅ N			Mols. Hg(CN) ₂ t°. per 100 Mols. Solid Phase. Hg(CN) ₂ + C ₅ H ₅ N			Mols. Hg(CN) ₂ t°. per 100 Mols. Solid Phase. Hg(CN) ₂ + C ₅ H ₅ N		
9	7.1	Hg(CN) ₂ .6C ₅ H ₅ N	22.5	17.3	Hg(CN) ₂ .2C ₅ H ₅ N	56.5	26.6	2Hg(CN) ₂ .3C ₅ H ₅ N
11	8.7	"	28.5	18.4	"	68	27.5	Hg(CN) ₂ .C ₅ H ₅ N
12.2	10.4	"	32	19.3	"	70	27.7	"
13	11.3	"	38	20.6	"	86	29	"
13.5	12.9	"	42	22.3	"	111	32	"
14.5	13.8	"	46	23.7	"	122.5	33.8	"
16.5	15.8	"	53	25.3	2Hg(CN) ₂ .3C ₅ H ₅ N	125	34.4	"
20.5	15.9	"	54.5	26	"	141	38.3	"

100 gms. pyridine dissolve 64.8 gms. Hg(CN)₂ at 18°. (Schroeder, 1905.)

SOLUBILITY OF MERCURIC CYANIDE IN QUINOLINE. (Staronka, 1910.)

t°. Mols. Hg(CN) ₂ per 100 Mols. Solid Phase. Hg(CN) ₂ +C ₈ H ₇ N.			t°. Mols. Hg(CN) ₂ per 100 Mols. Solid Phase. Hg(CN) ₂ +C ₈ H ₇ N.		
45	4.2	Hg(CN) ₂ .3C ₈ H ₇ N	137	13.2	Hg(CN) ₂ .2C ₈ H ₇ N(?)
54	6	" tr. pt. 60°	161	17.4	"
89 (61°)	8.2		180	22.5	"
99 (61°)	9.2		192	27.1	"

CN

100 gms. liquid Sulfur Dioxide dissolve 0.014 gm. Hg(CN)₂ at 0°. (Jander and Ruppolt, 1937.)

MERCURY Oxy CYANIDE HgO.Hg(CN)₂.

SOLUBILITY OF MERCURY OXY CYANIDE IN AQUEOUS SOLUTIONS AT 18-20°. (Bordeleanu, 1933.)

In aqueous solutions of:

KNaC ₄ H ₄ O ₆ .4H ₂ O		NaCH ₃ COO		H ₃ BO ₃	
Oms. per 100 gms. sat. sol. KNaC ₄ H ₄ O ₆	HgO.Hg(CN) ₂	Oms. per 100 gms. sat. sol. NaCH ₃ COO	HgO.Hg(CN) ₂	Oms. per 100 gms. sat. sol. H ₃ BO ₃	HgO.Hg(CN) ₂
0.0	1.315	8.25	1.291	0.4	1.80
12.0	3.18	18.74	1.170	1.4	1.94
20.0	4.39	35.72	1.063	2.4	2.00
42.0	5.73			3.4	2.18

The author also gives results showing that the presence of Hg(CN)₂ has little effect upon the above solubilities.

CNS

MERCUROUS THIOCYANATE Hg₂(SCN)₂.

The Solubility Product of Mercurous Thiocyanate in Water at 25° is 3.0×10^{-20} as quoted by Brodsky, 1929 from Immerwahr, and 1.4×10^{-20} as quoted from Grossmann, 1905.

MERCURIC THIOCYANATE $\text{Hg}(\text{SCN})_2$ EQUILIBRIUM IN THE SYSTEM MERCURIC THIOCYANATE, POTASSIUM THIOCYANATE AND WATER AT 25° .

(Mason and Forgeng, 1931.)

The authors determined the following triple points of the system:

Gms. per 100 gms. sat. sol.		Solid Phase
KSCN	$\text{Hg}(\text{SCN})_2$	
0.0	0.063	$\text{Hg}(\text{SCN})_2$
2.05	4.05	" + $\text{KHg}(\text{SCN})_3$
33.1	49.1	$\text{K}_2\text{Hg}(\text{SCN})_4$ + "
66.4	10.4	" + KSCN
70.5	0.0	KSCN

CNS

MERCURIC THIOCYANATE

100 gms. liquid Sulfur Dioxide dissolve 0.02 gm. $\text{Hg}(\text{SCN})_2$ at 0° . (Jander and Ruppolt, 1937.)

MERCURIC Zinc THIOCYANATE $\text{HgZn}(\text{SCN})_4$.

SOLUBILITY OF MERCURIC ZINC THIOCYANATE IN AQUEOUS SOLUTIONS OF AMMONIUM CHLORIDE.

(Cuveller, 1935.)

Measured amounts of aqueous solutions of $\text{HgNa}_2(\text{SCN})_4$, $\text{Zn}(\text{NO}_3)_2$, $\text{Cu}(\text{SCN})_2$ and NH_4Cl of known concentration were mixed and the amount of zinc not precipitated as $\text{HgZn}(\text{CNS})_2$ was determined by a colorimetric comparison. Thus the amount of $\text{HgZn}(\text{SCN})_4$ remaining in solution at each concentration of NH_4Cl was estimated by difference.

Normality of Aq. NH_4Cl	Gms. $\text{HgZn}(\text{SCN})_4$ per 100 gms. sat. sol.	Normality of Aq. NH_4Cl	Gms. $\text{HgZn}(\text{SCN})_4$ per 100 gms. sat. sol.
0.022	0.0766	0.714	0.462
0.044	0.110	1.000	0.505
0.089	0.173	1.428	0.534
0.178	0.255	1.843	0.546
0.357	0.353		

MERCUROUS CARBONATE Hg_2CO_3

The Solubility Product of mercurous carbonate in water at 25° is 9.0×10^{-17} as quoted from Immerwahr by Brodsky, 1929.

MERCUROUS OXALATE $\text{Hg}_2\text{C}_2\text{O}_4$

The Solubility Product of mercurous oxalate in water at 25° is $(2) \times 10^{-13}$ as quoted from Behrend by Brodsky, 1929.

COO

MERCURIC OXALATE HgC_2O_4 .

100 gms. H_2O dissolve 0.0107 gm. HgC_2O_4 at 20° . (Trifnov, 1924, 1925.)

Data for the system $\text{HgC}_2\text{O}_4 + \text{K}_2\text{C}_2\text{O}_4 + \text{H}_2\text{O}$ at 20° are also given. The five branches of the curve have, respectively, for solid phase: HgC_2O_4 ; $\text{K}_2\text{C}_2\text{O}_4 \cdot \text{HgC}_2\text{O}_4 \cdot 2\text{H}_2\text{O}$, $2\text{K}_2\text{C}_2\text{O}_4 \cdot \text{HgC}_2\text{O}_4 \cdot 3\text{H}_2\text{O}$, $3\text{K}_2\text{C}_2\text{O}_4 \cdot \text{HgC}_2\text{O}_4 \cdot 4\text{H}_2\text{O}$ and $\text{K}_2\text{C}_2\text{O}_4$.

MERCUROUS CHLORIDE Hg_2Cl_2

SOLUBILITY OF MERCUROUS CHLORIDE IN WATER.

t°.	Gms. Hg_2Cl_2 per 100 Gms. Sat. Sol.	Authority.	t°.	Gms. Hg_2Cl_2 per 100 Gms. Sat. Sol.	Authority.
0.5	0.000140	(Conductivity, Kohlrausch, 1908.)	24.6	0.00028	(Kohlrausch, 1908.)
18	0.000075	(Indirect, Behrend, 1893.)	25	0.000047	(Sherrill, 1903.)
18	0.00021	(Conductivity, Kohlrausch, 1908.)	43	0.00070	(Kohlrausch, 1908.)
20	0.000038	(Ley and Heimbucher, 1904.)			

The solubility product of mercurous chloride, determined by a modified electro-metric method, was found by Brodsky and Scherschewer, 1926, to be $2.0 \cdot 10^{-19}$ at 11° , $3.4 \cdot 10^{-19}$ at 15° , $5.3 \cdot 10^{-19}$ at 19° and $12.2 \cdot 10^{-19}$ at $26^\circ 5$.

Subsequent determinations by Brodsky, 1929, gave the following values: 2.22×10^{-19} at 10.8° , 3.31×10^{-19} at 14.9° , 5.42×10^{-19} at 19.2° and 15.1×10^{-19} at 26.5° .

HYDRARGYRUM CHLORIDE (ic) HgCl_2

SOLUBILITY OF MERCURIC CHLORIDE IN WATER.

Average curve from results of Etard, 1894; Foote, 1903; Osaka, 1903-08; Herz and Paul, 1913; Greenish and Smith, 1903; Schreinemakers and Thonus, 1912; Sherrill, 1903; Morse, 1902.

Cl

t°.	Gms. HgCl_2 per 100 Gms. Sat. Sol.	t°.	Gms. HgCl_2 per 100 Gms. Sat. Sol.	t°.	Gms. HgCl_2 per 100 Gms. Sat. Sol.
0	3.5	25	6.9	80	23.1
10	4.6	30	7.7	100	38
15.5	5.3 ($d_{15} = 1.047$)	40	9.3	120	59
20	6.1	60	14	150	78.5

SOLUBILITY OF MERCURIC CHLORIDE IN WATER.

t°.	d of sat. sol.	Gms. HgCl_2 per 100 gms. sat. sol.	t°.	d of sat. sol.	Gms. HgCl_2 per 100 gms. sat. sol.
18.....	—	6.24 (1)	56.....	1.109	13.7 (3)
25.....	—	6.76 (2)	80.....	1.194	23.4 (3)
34.....	1.068	8.55 (3) (4)	100.....	1.348	36.0 (3)

(1) Laird, 1920; (2) Moles and Marquina, 1914, 1924; (3) Tourneux, 1919; (4) Toda, 1921.

More recent determinations have given the following results:

t°	d of sat. sol.	Gms. HgCl_2 per 100 gms. sat. sol.	t°	Gms. HgCl_2 per 100 gms. sat. sol.	t°	Gms. HgCl_2 per 100 gms. sat. sol.
15	1.0457	5.426 (1)	105	38.9 (5)	157	80.0
20	1.0518	6.167 (1)	116	49.0	165	82.6
25	1.0560	6.806 (1)	123	55.3	175	86.5
25	—	6.584 (2)	129	61.5	182	88.8
25	—	6.732 (3)	133	65.1	195	91.4
30	—	7.55 (4)	141	70.6	206	93.0
70	—	19.12 (4)	145	73.2	235	96.0

(1) Flöttmann, 1928; (2) Benrath, 1927; (3) Benrath and Ammer, 1929; (4) Sugden, 1929; (5) above 100° , Benrath, Gjedebo, Schiffers and Wunderlich, 1937.

EQUILIBRIUM IN THE SYSTEM MERCURIC CHLORIDE, MERCURIC IODIDE AND WATER.

(Sugden, 1929.)

Suitable mixtures of the two salts in water were heated to 100° and then rapidly filtered. The solutions thus obtained, from which solids separate, were rotated up to 11 days. It was necessary to operate in this manner since equilibrium is established too slowly if solids are present from the beginning. Due to analytical difficulties great accuracy is not claimed for the results. The solid phase in the iodide region consists of two series of mixed crystals which are respectively yellow and red. They correspond to the yellow and red form of the simple iodide stable above and below 129°.

Results at 30°			Results at 70°		
Gms. per 100	gms. sat. sol.	Solid Phase	Gms. per 100	gms. sat. sol.	Solid Phase
HgCl ₂	HgI ₂		HgCl ₂	HgI ₂	
7.55	0.0	W	19.12	0.0	W
7.67	0.41	"	19.5	0.44	"
7.75	0.21	"	20.5	1.10	Y
7.77	0.43	" + R	19.8	1.02	"
7.72	0.54	R	17.4	0.99	"
7.69	0.46	"	16.7	1.00	"
6.75	0.31	"	12.8	0.99	"
5.32	0.28	"	12.6	0.94	"
3.39	0.33	"	10.2	0.91	" + R
2.20	0.18	"	9.9	0.84	" + R
7.82	0.52	Y	7.35	0.75	R
5.36	0.37	"	3.94	0.52	"

W = White, R = Red, Y = Yellow.

MERCUROUS CHLORIDE HgCl

SOLUBILITY OF MERCUROUS CHLORIDE (CALOMEL) IN AQUEOUS SOLUTIONS OF SODIUM CHLORIDE, BARIUM CHLORIDE, CALCIUM CHLORIDE AND OF HYDROCHLORIC ACID AT 25°. (Richards and Archibald, 1902.)

Solid phase in each case. Calomel + about 0.1 gm. of mercury.

In Aqueous NaCl.

Sp. Gr. of Solutions.	Gms. per Liter.	
	NaCl.	HgCl.
...	5.85	0.0041
1.040	58.50	0.041
1.078	119	0.129
1.093	148.25	0.194
1.142	222.3	0.380
1.188	292.5	0.643

In Aqueous BaCl₂.

Sp. Gr. of Solutions.	Gms. per Liter.	
	BaCl ₂ .	HgCl.
1.088	104.15	0.044
1.134	156.22	0.088
1.174	208.30	0.107
1.263	312.54	0.231

In Aqueous CaCl₂.

Sp. Gr. of Solutions.	Gms. per Liter.	
	CaCl ₂ .	HgCl.
...	39.96	0.022
...	55.5	0.033
1.064	111	0.081
1.105	138.75	0.118
1.151	195.36	0.231
1.205	257.52	0.322
1.243	324.67	0.430
1.315	432.9	0.518
1.358	499.5	0.510

In Aqueous HCl.

Sp. Gr. of Solutions.	Gms. per Liter.	
	HCl.	HgCl.
...	31.69	0.034
...	36.46	0.048
1.042	95.43	0.207
1.069	158.4	0.399
1.091	209.2	0.548
1.114	267.3	0.654
1.119	278.7	0.675
1.132	317.3	0.670
1.153	364.6	0.673

100 gms. bromoform, CHBr₃, dissolve 0.055 gm. HgCl at 18°-20°. (Sulc., 1900.)

Data for the system Mercurous Chloride + KOH + H₂O at 25° are given by Herz, 1911.

MERCURIC CHLORIDE HgCl_2

SOLUBILITY OF MERCURIC CHLORIDE IN AQUEOUS SALT SOLUTIONS AT 25°.
(Herz and Paul, 1913.)

In Aqueous Barium Chloride.		In Aqueous Calcium Chloride.		In Aqueous Lithium Chloride.		In Aqueous Magnesium Chloride.	
Mols. per Liter.		Mols. per Liter.		Mols. per Liter.		Mols. per Liter.	
BaCl_2	HgCl_2	CaCl_2	HgCl_2	LiCl	HgCl_2	MgCl_2	HgCl_2
0	0.265	0.190	0.364	0.414	0.351	0.168	0.374
0.385	0.697	0.402	0.766	0.835	0.666	0.415	0.719
0.572	1.167	0.656	1.108	1.271	1.021	0.570	1.131
0.776	1.620	0.964	1.811	1.738	1.678	0.997	1.864
1.336	2.645	1.429	2.645	2.265	2.214	1.320	2.569
3.030	5.348	1.723	3.304	3.091	2.896	1.728	3.206

Cl	In Aqueous Potassium Chloride.		In Aqueous Sodium Chloride.		In Aqueous Strontium Chloride.	
	Mols. per Liter.		Mols. per Liter.		Mols. per Liter.	
	KCl	HgCl_2	NaCl	HgCl_2	SrCl_2	HgCl_2
0	0.265		0.201	0.372	0.164	0.315
0.1	0.381	(Sherrill, 1903.)	0.416	0.508	0.311	0.563
0.174	0.355		0.671	0.748	0.519	0.829
0.221	0.381		1.153	1.192	0.724	1.342
0.25	0.542	(Sherrill, 1903.)	1.941	2.022	1.046	1.776
0.683	0.836		3.162	3.434	1.384	2.293

SOLUBILITY OF MERCURIC CHLORIDE IN AQUEOUS SOLUTIONS OF
HYDROCHLORIC ACID AT:

0°.

(Engel — Ann. chim. phys. [6] 17, 362, '89.)

20–25° (?).

(Ditte — *Ibid.* [5] 22, 551, '81.)

Mg.	Mols. per 100 cc. Sol.	Gms. per 100 cc. Sol.	Sp. Gr. of Solutions.	Parts HCl per 100 Parts H_2O .	Parts HgCl_2 per 100 Parts Solution.	
HCl.	$\frac{1}{2}\text{HgCl}_2$.	HCl.	HgCl_2 .			
4.3	9.7	1.57	13.11	1.117	0.0	6.8
9.9	19.8	3.61	18.04	1.238	5.6	46.8
17.8	35.5	6.49	32.44	1.427	10.1	73.7
26.9	55.6	9.81	49.04	1.665	13.8	87.8
32.25	68.9	11.76	58.80	1.811	21.1	127.4
34.25	72.4	12.48	62.40	1.874	31.0	141.9
41.5	85.5	15.13	75.65	2.023	50.0	148.0
48.1	88.6	17.54	87.70	2.066	68.0	154.0
70.9	95.7	25.84	129.20	2.198		

One liter of 0.1 N $\text{Hg}(\text{NO}_3)_2$ solution dissolves 105 gms. HgCl_2 at 25°.

(Morse, 1902.)

This result, together with distribution experiments, show that complexes of HgCl_2 and $\text{Hg}(\text{NO}_3)_2$ are formed.

EQUILIBRIUM IN THE SYSTEM MERCURIC CHLORIDE, YELLOW MERCURIC OXIDE
AND WATER AT 35°. (Toda, 1921.)

The various mixtures were rotated in a thermostat for about 72 hours, and both the clear solution and solid phases were analyzed.

Gms. per 100 gms. sat. sol.		Solid Phase.	Gms. per 100 gms. sat. sol.		Solid Phase.
Hg Cl ₂ .	Hg O.		Hg Cl ₂ .	Hg O.	
8.58	0.0	Hg Cl ₂	0.61	0.02	Hg Cl ₂ .4 Hg O
8.72	0.14	» + Hg Cl ₂ .2 Hg O	0.23	0.03	»
8.68	0.07	»	0.20	0.06	»
8.69	0.10	»	0.13	0.04	» + Hg O
8.81	0.03	»	0.07	0.04	»
8.70	0.11	»	0.05	0.03	»
8.69	0.10	»	0.05	0.04	»
4.39	0.09	Hg Cl ₂ .2 Hg O	0.04	0.04	Hg O
3.42	0.06	»	0.01	0.03	»
0.66	0.02	»	0.00	0.001	»
0.66	0.02	» + Hg Cl ₂ .4 Hg O			

EQUILIBRIUM IN THE SYSTEM MERCURIC CHLORIDE, POTASSIUM CHLORIDE,
AND WATER AT 34°. (Tourneux, 1919.)

Saturation was secured by constant stirring. Both the saturated solutions and solid phases were analyzed.

Gms. per 100 gms. sat. sol.			Solid Phase.	Gms. per 100 gms. sat. sol.			Solid Phase.
d of sat. sol.	Hg Cl ₂ .	K Cl.		d of sat. sol.	Hg Cl ₂ .	K Cl.	
1.068	8.55	0.0	Hg Cl ₂	1.386	27.9	9.6	Hg Cl ₂ .KCl.1/4 H ₂ O
1.202	19.14	2.6	»	1.368	25.5	11.4	»
-	27.2	4.2	»	1.428	26.8	14.9	»
-	34.1	5.4	»	1.561	30.8	20.0	»
1.497	37.0	6.0	»	1.620	32.6	22.0	»
1.512	37.4	6.0	» + 2Hg Cl ₂ .KCl.2H ₂ O	1.624	33.0	21.9	» + Hg Cl ₂ .2KCl.H ₂ O
1.525	37.8	6.5	2Hg Cl ₂ .KCl.2H ₂ O	1.621	32.8	21.9	Hg Cl ₂ .2KCl.H ₂ O
1.533	37.7	6.7	»	-	29.0	23.0	»
1.545	37.6	7.3	»	-	24.5	24.8	»
1.549	37.8	7.45	» + 3Hg Cl ₂ .2KCl.3/2 H ₂ O	1.459	20.65	26.0	» + KCl
1.534	37.4	7.8	3Hg Cl ₂ .2KCl.3/2 H ₂ O	-	17.8	26.8	KCl
1.530	37.6	8.0	»	-	12.2	27.0	»
1.524	36.8	8.2	» + Hg Cl ₂ .KCl.1/2 H ₂ O	-	8.4	27.3	»
1.512	35.9	8.2	Hg Cl ₂ .KCl.1/2 H ₂ O	-	4.5	27.5	»
1.486	34.5	8.5	»	-	0.0	27.8	»

Results similar to the above are given for 56°, 80° and 100°.

In a later paper by Tourneux, 1934, having for its object an explanation of the variation in the solubility of HgCl₂ in aq. solutions of KCl and vice versa, the author calculates the equilibrium constants involved and finds that they vary with the temperature in accordance with the law of Van't Hoff.

Data for the system HgCl₂ + KCl + NH₄Cl + H₂O at 25° are given by Osaka and Ando 1925, 1926.

SOLUBILITY OF MERCURIC CHLORIDE IN AQUEOUS SOLUTIONS OF POTASSIUM
CHLORIDE AT 20° AND VICE VERSA.

(Tichomirow, 1907; see also results by Foote and Levy)

Gms. per 100 Gms. H ₂ O.		Solid Phase.	Gms. per 100 Gms. H ₂ O.		Solid Phase.
KCl.	HgCl ₂ .		KCl.	HgCl ₂ .	
0	7.39	HgCl ₂	20.35	29	HgCl ₂ .KCl
1.12	11.63	"	26.31	34.83	"
2.39	15.72	"	30.32	39.10	"
4.05	22.17	"	34.12	42.82	" + HgCl ₂ .2KCl
4.84	25.16	" + 2HgCl ₂ .KCl	34.18	39.34	HgCl ₂ .2KCl
5.60	25.13	2 HgCl ₂ .KCl	34.34	35.16	"
6.71	25.66	"	35.54	30.63	"
7.39	26.41	" + HgCl ₂ .KCl	37.72	24.30	"
7.46	24.70	HgCl ₂ .KCl	41.33	19.33	" + KCl
8.95	19.93	"	39.66	15.76	KCl
15	22.87	"	37.87	10.28	"
17.57	26.12	"	35.32	2.1	"

SOLUBILITY OF MIXTURES OF POTASSIUM AND MERCURIC CHLORIDES
IN WATER AT 25°.

(Foote and Levy.)

Cl

Composition of Solution. Grams per 100 Grams Solution.		Percentage Composition of Undissolved Residue			Solid Phase.
KCl.	HgCl ₂ .	KCl.	HgCl ₂ .	H ₂ O.	
26.46	none	100	none	...	KCl
26.24	15.04	...	3.63	...	KCl and 2KCl.HgCl ₂ .H ₂ O
26.43	15.02	...	26.15	...	
26.33	15.02	...	52.01	...	
26.33	14.92	...	61.04	...	
23.74	18.91	34.61	61.66	3.73	2KCl.HgCl ₂ .H ₂ O Calc. Composition 34.05% KCl, 61.84% HgCl ₂ , 4.11% H ₂ O
22.36	21.39	34.77	62.02	3.21	
21.39	23.88	34.80	61.84	3.35	
20.32	27.62	...	65.24	...	
20.26	27.38	...	73.98	...	2KCl.HgCl ₂ .H ₂ O and KCl.HgCl ₂ .H ₂ O
17.85	25.34	21.89	75.10	3.01	
9.26	18.95	21.02	73.36	5.62	KCl.HgCl ₂ .H ₂ O Calc. Composition 20.52% KCl, 74.53% HgCl ₂ , 4.95% H ₂ O
7.80	19.56	20.76	73.06	6.18	
6.84	22.81	20.75	74.54	4.71	
6.66	24.32	20.54	73.99	5.47	
6.52	25.13	...	76.46	...	KCl.HgCl ₂ .H ₂ O and KCl.2HgCl ₂ .2H ₂ O
6.64	25.16	...	80.60	...	
6.27	25.11	12.09	83.20	4.71	KCl.2HgCl ₂ .2H ₂ O Calc. Composition 11.43% KCl, 83.05% HgCl ₂ , 5.52% H ₂ O
5.77	24.73	11.87	83.18	4.95	
4.68	24.75	...	84.46	...	KCl.2HgCl ₂ .2H ₂ O and HgCl ₂
4.66	25.17	...	93.68	...	
4.69	24.82	...	98.50	...	
none	6.90	none	100.00	none	HgCl ₂

Data for the quaternary system Ammonium Chloride + Mercuric Chloride + Potassium Chloride + Water at 25° are given by Osaka and Ando, 1924.

The results of these authors have been further interpreted in a paper by Jänecke, 1938.

Data for equilibrium in the system $\text{HgCl}_2 + \text{KOH} + \text{H}_2\text{O}$ at 25° are given by Herz, 1910.

SOLUBILITY OF MERCURIC CHLORIDE IN AQUEOUS SOLUTIONS OF
MAGNESIUM CHLORIDE AT 25° AND VICE VERSA.

(Bassett, Barton, Foster and Pateman, 1933.)

Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase
HgCl_2	HgCl_2		HgCl_2	HgCl_2		HgCl_2	HgCl_2	
6.90	0.0	HgCl_2	53.15	16.30	B	44.93	21.12	C
33.47	5.4	"	51.88	17.27	"	43.20	21.95	" + D
47.72	8.28	"	50.08	18.77	" + C	41.66	22.43	D
56.03	9.86	"	49.85	19.23	B	31.92	25.29	"
57.46	10.68	"	49.47	19.07	C	24.29	27.64	"
59.23	12.48	" + B	48.95	19.22	"	11.76	31.72	"
55.90	14.44*	B	48.78	19.45	"	0.58	35.48	"
55.78	14.38	"	47.32	20.01	"	0.0	35.70	"
54.53	15.24	"	45.45	20.90	"			

* Metastable

B = $[\text{Hg}(\text{H}_2\text{O})_6]^{2+} [\text{Hg}_3\text{Cl}_8]^{2-}$; C = $[\text{Mg}(\text{H}_2\text{O})_6]^{2+} [\text{HgCl}_4]^{2-}$; D = $[\text{Mg}(\text{H}_2\text{O})_6]^{2+} \text{Cl}_2$.

SOLUBILITY OF MERCURIC CHLORIDE IN AQUEOUS SOLUTIONS OF
SODIUM CHLORIDE.

(Hornsey and Ritsert — Pharm. Ztg. 33, 738, '88.)

Per cent Concentration of NaCl Solutions.	Gms. HgCl_2 per 100 Gms. NaCl Solution at:		
	15°	65°	100°
0.5	10	13	44
1.0	14	18	48
5.0	30	36	64
10.0	58	68	110
25.0	120	142	196
26.0 (saturated)	128	152	208

100 gms. of aqueous 1.0 normal NaCl solution dissolve 25.08 gms. HgCl_2 at 25°. (Osaka, 1903-08.)

EQUILIBRIUM IN THE SYSTEM AMMONIUM CHLORIDE, MERCURIC CHLORIDE, WATER AT 30°.

(Meerburg, 1908.)

Gms. per 100 Gms. Sat. Sol.		Solid Phase.	Gms. per 100 Gms. Sat. Sol.		Solid Phase.
HgCl ₂ .	NH ₄ Cl.		HgCl ₂ .	NH ₄ Cl.	
0	29.50	NH ₄ Cl	57.05	9.92	3.2.1
22.80	26.91	"	58.65	9.20	" +9.2
42.45	25.05	"	*51.83	8.76	9.2
50.05	24.79	" 1.2.1	*46	7.52	"
53.08	22.77	1.2.1	*35.60	5.26	"
58.90	20.02	" +1.1.1	*32.90	5.06	"
56.38	18.50	1.1.1	29.65	3.62	" +HgCl ₂
55.58	16.82	"	40.12	5.13	HgCl ₂
57.01	14.12	" +3.2.1	21	2.29	"
56.26	13.04	3.2.1	7.67	0	"

1.2.1 = HgCl₂.2NH₄Cl.H₂O; 1.1.1 = HgCl₂.NH₄Cl.H₂O;3.2.1 = 3HgCl₂.2NH₄Cl.H₂O; 9.2 = 9HgCl₂.2NH₄Cl.

* In these solutions 2 to 3 weeks were required for attainment of equilibrium.

Cl

SOLUBILITY OF MIXTURES OF SODIUM AND MERCURIC CHLORIDE IN WATER AT 25°.

(Foote and Levy — Am. Ch. J. 35, 239, '06.)

Gms. per 100 Gms. Solution.		Gms. per 100 Gms. Undissolved Residue.			Solid Phase.
NaCl.	HgCl ₂ .	NaCl.	HgCl ₂ .	H ₂ O.	
26.5	none	100	none	none	NaCl
18.66	51.35	...	16.39	...	NaCl and NaCl.HgCl ₂ .2H ₂ O
18.71	51.32	...	21.98	...	
18.64	51.42	...	65.42	...	
18.87	51.26	...	71.25	...	Double Salt NaCl.HgCl ₂ .2H ₂ O Calc. Comp. = 16.01% NaCl 74.14% HgCl ₂ .9.85% H ₂ O
14.97	57.74	16.38	74.18	9.44	
14.03	59.69	16.36	74.21	9.43	
13.25	62.16	16.16	74.70	9.14	NaCl.HgCl ₂ .2H ₂ O and HgCl ₂
13.17	62.59	15.96	74.76	9.28	
12.97	62.50	...	78.20	...	
13.14	62.48	...	88.64	...	NaCl.HgCl ₂ .2H ₂ O and HgCl ₂
13.15	62.55	...	90.83	...	

Two determinations made at 10.3° gave:

19.46	46.49	67.46	29.19	3.35
19.48	46.50	22.83	68.85	8.32

SOLUBILITY OF MIXTURES OF MERCURIC AND RUBIDIUM CHLORIDES IN
WATER AT 25°.

(Foote and Levy, 1906.)

Composition of Solution. Gms. per 100 Gms. Solution.		Percentage Composition of Undissolved Residue.			Solid Phase.
RbCl.	HgCl ₂	RbCl.	HgCl ₂ .	H ₂ O.	
48.57	none	100	none	none	RbCl
46.76	9.18	88.04	11.24	0.72	RbCl and 2RbCl.HgCl ₂ .H ₂ O
47.54	9.49	60.33	37.51	2.16	
47.55	9.39	56.59	40.75	2.66	
47.3	9.47	46.73	49.38	3.88	2RbCl.HgCl ₂ .H ₂ O Calc. Com- position 45.55% RbCl, 51.05% HgCl ₂ , 3.4% H ₂ O
47.65	10.35	46.50	50.92	2.58	
35.16	19.58	45.98	50.80	3.22	
34.77	19.94	43.07	52.44	4.49	2RbCl.HgCl ₂ .H ₂ O and 3RbCl. 2HgCl ₂ .2H ₂ O
34.76	20.10	41.10	55.36	3.54	
30.27	20.17	39.07	57.34	3.59	
29.20	20.55	39.10	57.47	3.43	Calc. Composition 38.55% RbCl, 57.62% HgCl ₂ , 3.82% H ₂ O
27.38	20.63	38.67	57.40	3.93	
26.83	20.87	38.48	57.36	4.16	
27.09	20.97	31.40	64.35	4.25	3RbCl.2HgCl ₂ .2H ₂ O and RbCl.HgCl ₂ .H ₂ O
26.15	20.58	30.34	65.48	4.18	
23.81	18.71	30.87	65.10	4.03	
18.10	14.25	29.87	65.28	4.85	Calc. Composition 29.49% RbCl, 66.11% HgCl ₂ , 4.40% H ₂ O
10.87	10.42	29.33	66.15	4.52	
10.68	10.56	28.59	67.99	3.42	
10.50	10.05	26.22	72.20	1.58	RbCl.HgCl ₂ .H ₂ O and 3RbCl 4HgCl ₂ .H ₂ O
10.06	9.86	25.28	73.38	0.84	
8.48	8.71	25.30	73.15	1.55	
8.46	8.80	25.44	73.67	0.89	3RbCl.4HgCl ₂ .H ₂ O Calc. Composition 24.76% RbCl, 74.01% HgCl ₂ , 1.23% H ₂ O
5.68	8.70	25.09	73.46	1.45	
5.10	8.33	24.92	73.93	1.15	
3.43	8.25	22.79	75.72	1.49	3RbCl.4HgCl ₂ .H ₂ O and RbCl 5HgCl ₂
3.38	8	12.68	86.74	0.58	
2.98	7.71	8.40	91.24	..	
1.89	7.64	8.38	91.78	...	RbCl.5HgCl ₂ Calc. Composition 8.20% RbCl, 91.8% HgCl ₂
1.50	7.55	8.30	91.81	...	
1.10	7.21	8.07	91.58	..	
0.79	7.16	6.91	93.15	..	RbCl.5HgCl ₂ and HgCl ₂
0.84	7.42	2.27	97.09	...	
none	6.90	none	100	...	

Cl

MERCURIC CHLORIDE HgCl_2

SOLUBILITY OF MERCURIC CHLORIDE IN AQUEOUS SOLUTIONS OF STRONTIUM CHLORIDE AT 25° AND VICE VERSA.

(Bassett, Barton, Foster and Pateman, 1933.)

Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase
HgCl_2	SrCl_2		HgCl_2	SrCl_2		HgCl_2	SrCl_2	
6.90	0.0	HgCl_2	56.20	19.20	B - S	0.0	40.0*	D
34.70	9.30	"	55.45	19.82	"	48.20	23.60	E
48.21	13.93	"	54.33	20.88	"	46.25	24.02	"
56.62	16.65	"	52.70	21.90	"	45.32	24.26	"
57.17	17.34	"	51.20	22.50	"	34.52	26.78	"
58.38	18.02	" + B + S	50.87	22.98	"	31.02	27.50	"
58.68	18.47*	" + C	48.90	23.69	" + E	18.82	30.50	"
58.49	19.42*	C	48.81	24.01	"	8.55	33.42	"
59.49	19.66*	"	48.77	23.90*	"	0.0	35.84	"
58.13	18.00	B + S						

* = Metastable

B = $[\text{Sr}(\text{H}_2\text{O})_6]^{2+} [(\text{HgCl}_2)_2\text{Cl}_2]^-$; C = $[\text{Sr}(\text{H}_2\text{O})_6]^{2+} [(\text{HgCl}_2)_6\text{Cl}_2]^{4-}$; D = $\text{SrCl}_2 \cdot 2\text{H}_2\text{O}$; E = $\text{SrCl}_2 \cdot 6\text{H}_2\text{O}$; S = solid solution.

Cl

SOLUBILITY OF MERCURIC CHLORIDE IN AQUEOUS ETHYL ALCOHOL AT 25° .
(Abe, 1912.)

Gms. per 100 $\text{C}_2\text{H}_5\text{OH}$.	Gms. Sat. Sol. HgCl_2 .	Solid Phase.	Gms. per 100 $\text{C}_2\text{H}_5\text{OH}$.	Gms. Sat. Sol. HgCl_2 .	Solid Phase.
$\text{C}_2\text{H}_5\text{OH}$.	HgCl_2 .		$\text{C}_2\text{H}_5\text{OH}$.	HgCl_2 .	
0	6.80	HgCl_2	45.84	15.36	HgCl_2
5.08	6.65	"	49.86	18.18	"
14.49	6.41	"	53.61	21.40	"
21	6.55	"	57.26	24.51	"
26.25	7.31	"	60.55	27.67	"
31.53	8.51	"	63.95	29.86	"
36.85	10.32	"	67.39	32.40	"
41.36	12.64	"			

SOLUBILITY OF MERCURIC CHLORIDE IN Aq. ETHYL ALCOHOL AT 25° .
(Herz and Anders, 1907.)

Wt. % $\text{C}_2\text{H}_5\text{OH}$ in Solvent.	d_{44}° of Solvent.	d_{44}° of Sat. Sol.	Gms. HgCl_2 per 100 cc. Sat. Sol.
0	0.9971	1.0565	7.22
20.18	0.9665	1.0214	6.76
40.69	0.9302	1.0180	10.69
70.01	0.8632	1.0616	23.60
100	0.7856	1.1067	36.86

The solid phase in contact with solutions of Mercuric Chloride plus Potassium Chloride in 95% or absolute ethyl alcohol at 34° was found to be $6\text{HgCl}_2 \cdot 5\text{KCl} \cdot 2\text{C}_2\text{H}_5\text{OH}$. (Pernot, 1934.)

SOLUBILITY OF MERCURIC CHLORIDE IN AQUEOUS METHYL ALCOHOL AT 25°.
(Herz and Anders, 1907.)

Wt. % CH ₃ OH in Solvent.	d_{25}^4 of Solvent.	d_{25}^4 of Sat. Sol.	Gms. HgCl ₂ per 100 cc. Sat. Sol.
10.60	0.9792	1.0441	7.90
30.77	0.9481	1.0420	11.31
37.21	0.9369	1.0507	13.43
47.06	0.9186	1.0809	19.71
64	0.8800	1.2015	38.44
78.05	0.8489	1.3314	57.17
100	0.7879	1.2160	48.62

100 cc. 90% ethyl alcohol dissolve 27.5 gms. HgCl₂ at 15.5°, d_{15} sat. sol. = 1.065.
(Greenish and Smith, 1903.)

100 gms. 99.2% ethyl alcohol dissolve 33.4 gms. HgCl₂ at 25°. (Osaka, 1903-8.)

" abs. " " 49.5 " " (de Bruyn, 1892.)

" " methyl " " 52.9 " " at 19.5° and 66.9 gms. at 25°. (de Bruyn, 1892.)

" " " " 1.2 " " at the crit. temp. (Centnerszwer, 1910.)

SOLUBILITY OF MERCURIC CHLORIDE IN METHYL, ETHYL PROPYL,
n BUTYL, ISO BUTYL AND ALLYL ALCOHOLS.

(Etard — Ann. chim. phys. [7] 2, 563, '94.)

NOTE. — For the solubility in Me, Et, and propyl alcohols at room temperature, see Rohland — Z. anorg. Ch. 18, 328, '98; at 8.5°, 20° and 38.2°, see Timofejew — Compt. rend. 112, 1224, '91; in Me and Et alcohols at 25°, see de Bruyn — Z. physik. Ch. 10, 783, '92. The determinations of these investigators agree well with those of Etard, which are given below.

C1

t°.	Grams HgCl ₂ per 100 Grams Saturated Solution in:					
	CH ₃ OH.	C ₂ H ₅ OH.	C ₃ H ₇ OH.	CH ₃ (CH ₂) ₃ OH.	(CH ₃) ₂ CHCH ₂ OH.	CH ₂ .CH.CH ₂ OH
-30	...	14.5	15.0	...	...	...
-20	...	20.1	15.7	13.5	...	21.0
-10	15.2	26.5	16.5	13.7	...	25.5
0	20.1	29.8	17.4	14.0	5.2	30.0
+10	26.3	30.6	18.0	14.3	6.0	37.5
20	34.0	32.0	18.8	14.6	6.8	46.5
25	40.0	32.5	19.5	15.5	7.2	...
30	44.4	33.7	20.0	16.5	7.5	...
40	58.6	35.6	23.0	19.6	9.7	...
60	62.5	41.2	29.8	26.5	17.0	...
80	66.0	47.5	36.8	33.0	24.9	...
100	70.1	54.3	43.8	...	31.7	...
120	73.5	61.5	50.6	...	39.2	...
150	78.5	...	...	...	...	...

SOLUBILITY OF MERCURIC CHLORIDE IN AQ. ETHYL ACETATE AT 25°.
(Herz and Anders, 1907.)

Wt. % CH ₃ COOC ₂ H ₅ in Solvent.	d_{25}^4 of Solvent.	d_{25}^4 of Sat. Sol.	Gms. HgCl ₂ per 100 cc. Sat. Sol.
0	0.9971	1.0565	7.22
4.39*	...	1.0581	7.38
96.76†	...	1.2371	41.55
100†	0.884	1.1126	26.42

* Almost sat. with ethyl acetate. † Ethyl acetate almost sat. with H₂O. ‡ (b. pt. = 75.77°.)

SOLUBILITY OF MERCURIC CHLORIDE IN AQUEOUS SOLUTIONS
OF ETHYL ALCOHOL AT 18°.

(Laird, 1920.)

Wt. % C_2H_5OH in solvent.	Gms. $HgCl_2$ per 100 gms. sat. sol.	Wt. % C_2H_5OH in solvent.	Gms. $HgCl_2$ per 100 gms. sat. sol.
0	6.24	25.0	5.08
10.0	5.63	30.0	5.86
15.0	5.43	40.0	7.58
20.0	5.15	51.0	11.30

SOLUBILITY OF MERCURIC CHLORIDE AT 23° IN AQUEOUS SOLUTIONS OF :
(Moles and Marquina, 1914, 1924.)

Citric Acid.		Tartaric Acid.		Glycerol.		Sucrose.	
Per cent Citric acid in solvent.	Gms. $HgCl_2$ per 100 gms. sat. sol.	Per cent Tartaric acid in solvent.	Gms. $HgCl_2$ per 100 gms. sat. sol.	Per cent Glycerol in solvent.	Gms. $HgCl_2$ per 100 gms. sat. sol.	Per cent Sucrose in solvent.	Gms. $HgCl_2$ per 100 gms. sat. sol.
0.0	6.76	10.0	6.36	5.08	7.20	10.0	7.08
10.0	6.63	20.0	5.75	15.1	8.33	25.0	8.05
25.0	5.73	25.0	5.36	25.0	9.60	30.0	8.46
50.0	3.99	35.0	4.59	35.0	11.10	35.0	8.83
		42.5	3.98	50.18	14.88	40.0	9.14
		50.0	3.28	75.08	26.53	42.5	9.16
				100.00	44.22	47.0	9.68
						55.0	10.14

C1

Ethyl ether, saturated with mercuric chloride by repeated agitation at room temperature, and also by prolonged boiling under a reflux condenser and allowing to stand at ordinary temperature for many days, contained 6.9 gms. $HgCl_2$ per 100 gms. ether. On the basis of 0.720 as the Sp. Gr. of the ether this corresponds to 5.0 gms. $HgCl_2$ per 100 cc. of ether.

(Richard, 1926.)

100 gms. glycerol of $d = 1.2326$ ($= 86.5\%$) dissolve 53.5 gm. $HgCl_2$ at 20°

» » » $d = 1.2645$ ($= 98.5\%$) » 65.5 » »

(Holm, 1921, 1922.)

100 gms. sat. solution of mercuric chloride in selenium oxychloride ($SeOCl_2$) contain 0.89 gm. $HgCl_2$ at 25°.

(Wise, 1923.)

100 gms. liquid Sulfur Dioxide dissolve 0.103 gm. $HgCl_2$ at 0°.

(Jander and Ruppolt, 1937.)

SOLUBILITY OF MERCURIC CHLORIDE IN AQUEOUS SOLUTIONS OF URETHAN AT 25°.

(Falitzsch, 1928, 1929.)

Gm. Mols. $HgCl_2$	per 1000 gms. H_2O	Solid Phase
$HgCl_2$	$NH_2COOC_2H_5$	
0.27	0.0	$HgCl_2$
0.30	1.1225	"
0.607	4.4898	"
1.552	11.326	"
0.25	51.79	" + $NH_2COOC_2H_5$

SOLUBILITY OF MERCURIC CHLORIDE IN ANHYDROUS ACETIC ACID
DETERMINED BY THE SYNTHETIC METHOD.

(Davidson and Chappell, 1938.)

t°	Mols. HgCl ₂ per 100 mols. HgCl ₂ + CH ₃ COOH	Solid Phase	t°	Mols. HgCl ₂ per 100 mols. HgCl ₂ + CH ₃ COOH	Solid Phase
16.6	0.0	CH ₃ COOH	53	1.46	HgCl ₂
16.45	0.27	"	60	1.61	"
16.35	0.477	"	66	1.81	"
17.0	0.477	HgCl ₂ · 2CH ₃ COOH	72	2.01	"
24	0.680	"	78	2.22	"
30	0.936	"	84	2.42	"
33	1.06	"	92	2.74	"
36	1.19	"	97	3.05	"
40	1.15	HgCl ₂	106	3.55	"
46	1.30	"	117	4.21	"

DISTRIBUTION OF MERCURIC CHLORIDE BETWEEN WATER AND BENZENE.
(Linhart, 1915.)

Results at 25°.

Results at 40°.

Mols. HgCl ₂ per Liter:		Conc. in H ₂ O	Mols. HgCl ₂ per Liter:		Conc. in H ₂ O
C ₆ H ₆ Layer.	H ₂ O Layer.	Conc. in C ₆ H ₆	C ₆ H ₆ Layer.	H ₂ O Layer.	Conc. in C ₆ H ₆
0.02100	0.2866	13.65	0.02647	0.34600	13.07
0.01224	0.15777	12.91	0.015296	0.18470	12.08
0.005244	0.064756	12.35	0.011774	0.138228	11.74
0.000618	0.007382	11.95	0.008041	0.091959	11.44
0.000310	0.003696	11.90	0.004140	0.04586	11.08
0.000155	0.001845	11.90	0.000847	0.009153	10.81

DISTRIBUTION OF MERCURIC CHLORIDE BETWEEN WATER AND AMYL ALCOHOL.
(Wossnessensky and Astachow, 1927.)

Mols. HgCl ₂ per liter		Conc. in H ₂ O
Water	Amyl Alcohol	Conc. in Amyl Alcohol
0.0072	0.013	0.554
0.0378	0.072	0.525
0.0688	0.139	0.495

SOLUBILITY OF MERCURIC CHLORIDE IN ACETIC ACID.
(Etard, 1894.)

t°.	Gms. HgCl ₂ per 100 Gms. Solution.	t°.	Gms. HgCl ₂ per 100 Gms. Solution.	t°.	Gms. HgCl ₂ per 100 Gms. Solution.
20	2.5	70	8.5	110	13.6
30	3.5	80	9.7	120	16.5
40	4.7	90	11	130	20.7
50	6	100	12.4	140	25.2
60	7.2			160	34.8

DISTRIBUTION OF MERCURIC CHLORIDE BETWEEN WATER AND ETHER.
(Hantzsch and Sebalt, 1899.)

50 cc. ether + 50 cc. sat. aqueous HgCl_2 solution were shaken together at different temperatures and after equilibrium was established the HgCl_2 in each layer determined.

t°.	Mols. HgCl_2 per Liter:		$\frac{c'}{c^2}$
	H_2O Layer (c').	$(\text{C}_2\text{H}_5)_2\text{O}$ Layer (c^2).	
0	0.0056	0.01407	0.391
10	0.0066	0.01415	0.467
17.5	0.0090	0.02150	0.419
25	0.0095	0.02076	0.429

Determinations by Skinner (1892) at room temp. using concentrations of HgCl_2 in the aqueous layer varying from 1.4 to 5.9 per cent, gave a distribution coefficient, $\frac{c_1}{c_2}$ = approximately 0.23.

DISTRIBUTION OF MERCURIC CHLORIDE BETWEEN AQUEOUS HCl AND ETHER
AT 18°. (Mylus, 1911.)

When 1 gm. of Hg as HgCl_2 is dissolved in 100 cc. of H_2O or aqueous HCl and shaken with 100 cc. of ether, the percentage of the Hg which goes into the ethereal layer is as follows:

Percentage Conc. of Aq. HCl	0 (= H_2O)	1	10	20
Per cent Hg in Ether Layer	69.4	13	0.4	0.2

DISTRIBUTION OF MERCURIC CHLORIDE BETWEEN WATER AND TOLUENE AT 24°. (Brown, 1898.)

Gms. HgCl_2 per 100 cc.		Gms. HgCl_2 per 100 cc.	
H_2O Layer.	$\text{C}_6\text{H}_5\text{CH}_3$ Layer.	H_2O Layer.	$\text{C}_6\text{H}_5\text{CH}_3$ Layer.
0.442	0.0270	1.816	0.130
0.732	0.0488	3.766	0.292
0.780	0.0542	3.754	0.298
1.192	0.0812	6.688*	0.528*

* This solution saturated.

Results at Dif. Temperatures.

(Hantzsch and Vagt, 1901.)

Results at 25°.

(Morse, 1902; Drucker, 1912;
Hantzsch and Vagt, 1901.)

t°.	Mols. HgCl_2 per Liter:		$\frac{c_1}{c_2}$	Mols. HgCl_2 per Liter:		$\frac{c_1}{c_2}$
	H_2O Layer (c_1).	$\text{C}_6\text{H}_5\text{CH}_3$ Layer (c_2).		H_2O Layer (c_1).	$\text{C}_6\text{H}_5\text{CH}_3$ Layer (c_2).	
0	0.0578	0.0047	12.35	0.18410	0.01590	11.6
10	0.0575	0.0050	11.60	0.09193	0.00807	11.4
20	0.0576	0.0050	11.40	0.04593	0.00410	11.1
30	0.0574	0.0051	11.20	0.02289	0.00211	10.8
50	0.0573	0.0052	11.25	0.01142	0.00108	10.5
				0.00573	0.00057	10

Data for the effect of $\text{Hg}(\text{NO}_3)_2$ upon the distribution are given by Morse (1902). Results for the effect of ZnCl_2 are given by Drucker (1912).

SOLUBILITY OF MERCURIC CHLORIDE IN WATER-ETHER MIXTURES AT 25°.

(Abe, 1912.)

Gms. per 100 Gms. Sat. Sol.		Solid Phase.
HgCl ₂ .	Ether.	
6.92	87.86	HgCl ₂
5.2	1.2	"
4.3	5.2	"
2.8	5.4	"
1.5	5.4	"

* (Solvent, ether sat. with H₂O.)

SOLUBILITY OF MERCURIC CHLORIDE IN MIXTURES OF ETHER AND ETHYL ALCOHOL AT 25°.

(Abe, 1912.)

Gms. per 100 Gms. Sat. Sol.		Gms. per 100 Gms. Sat. Sol.	
HgCl ₂ .	C ₂ H ₅ OH.	HgCl ₂ .	C ₂ H ₅ OH.
32.43	67.57	36.29	27.16
35.50	58.59	34.08	22.48
37.39	51.02	28.55	15.20
37.96	44.79	20.67	8.97
38.24	38.69	5.49	0
37.75	32.84		

SOLUBILITY OF MERCURIC CHLORIDE IN MIXTURES OF ALCOHOLS AT 25°.

(Herz and Kuhn, 1908.)

C1

In Mixtures of Ethyl and Methyl Alcohols. In Mixtures of Ethyl and Propyl Alcohols. In Mixtures of Methyl and Propyl Alcohols.

% CH ₃ OH in Solvent.	d ₄ ²⁰ of Sat. Sol.	Gms. HgCl ₂ per 100 cc. Sat. Sol.	% C ₂ H ₅ OH in Solvent.	d ₄ ²⁰ of Sat. Sol.	Gms. HgCl ₂ per 100 cc. Sat. Sol.	% C ₂ H ₅ OH in Solvent.	d ₄ ²⁰ of Sat. Sol.	Gms. HgCl ₂ per 100 cc. Sat. Sol.
0	1.107	36.86	0	1.1070	36.86	0	1.2160	48.62
4.37	1.130	39.43	8.1	1.0988	36.67	11.11	1.2278	50.34
10.40	1.157	42.61	17.85	1.0857	34.06	23.80	1.2848	57.14
41.02	1.294	58.37	56.6	1.0272	27.11	65.20	1.1568	42.28
80.69	1.321	61.67	88.6	0.9854	21.66	91.80	1.0090	25.09
84.77	1.288	57.82	91.2	0.9824	21.60	93.75	1.0029	23.23
91.25	1.254	53.85	95.2	0.9772	20.87	96.6	0.9851	21.52
100	1.216	48.62	100	0.9720	20.03	100	0.9720	20.03

SOLUBILITY OF MERCURIC CHLORIDE IN MIXTURES OF ETHYL ALCOHOL AND BENZENE AND OF ETHYL ALCOHOL AND CHLOROFORM AT DIFFERENT TEMPERATURES.

(Dukelski, 1907.)

In a Mixture of one mol. C ₂ H ₅ OH + one mol. C ₆ H ₆ .		In a Mixture of two mols. C ₂ H ₅ OH + one mol. C ₆ H ₆ .		In a Mixture of one mol. C ₂ H ₅ OH + one mol. CH ₂ Cl ₂ .		In a Mixture of two mols. C ₂ H ₅ OH + one mol. CHCl ₃ .	
t°.	Gms. HgCl ₂ per 100 Gms. Sat. Sol.	t°.	Gms. HgCl ₂ per 100 Gms. Sat. Sol.	t°.	Gms. HgCl ₂ per 100 Gms. Sat. Sol.	t°.	Gms. HgCl ₂ per 100 Gms. Sat. Sol.
-2.5	15.20	-5.2	19.45	-20.5	3.82	-20.5	6.60
0	15.40	0	20.13	-12	4.43	0	7.69
6	16.38	9.1	21.65	0	4.89	8	8.96
20.5	18.40	20.9	23.57	8	5.37	23	10.66
20.65	18.50	24.4	24.19	23	7.12	38.5	12.50
24.5	19.33	36.5	26.53	38.5	8.51	44.2	14.40
34.5	21.34	53.7	31.27	44.2	9.51		
54.4	24.84	74	38.74	45.6	9.98		
54.5	24.42						

Some of the determinations were made by the direct method of saturating the solution at a given temperature and determining the dissolved material by evaporating and weighing. Others were made by the synthetic method of Alexejew.

SOLUBILITY OF MERCURIC CHLORIDE IN MIXTURES OF METHYL ALCOHOL AND CHLOROFORM, METHYL ALCOHOL AND CARBON TETRACHLORIDE, AND METHYL ALCOHOL AND DICHLORETHANE AT DIFFERENT TEMPERATURES.

(Dukelski, 1907.)

In a Mixture of one mol. CH_3OH + one mol. CHCl_3 .		In a Mixture of two mols. CH_3OH + one mol. CHCl_3 .		In a Mixture of two mols. CH_3OH + one mol. CCl_4 .		In a Mixture of two mols. CH_3OH + one mol. $\text{C}_2\text{H}_4\text{Cl}_2$.	
t°.	Gms. HgCl_2 per 100 Gms. Sat. Sol.	t°.	Gms. HgCl_2 per 100 Gms. Sat. Sol.	t°.	Gms. HgCl_2 per 100 Gms. Sat. Sol.	t°.	Gms. HgCl_2 per 100 Gms. Sat. Sol.
-12	1.73	-12	3.33	0	5.20	0	13.33
0	3.51	0	6.73	7.7	6.69	12.5	21.30
8	5.63	8	8.21	24.9	14.06	20.8	29.23
23	10.15	23	16.56	30.6	19.40	25.3	34.78
24.9	10.71	24.9	18.45	35.5	20.50	30.2	36.87
30.6	11.40	30.6	19.70	36.1	21.80	37.4	37.95
38.5	12.02	38.5	20.83	48.5	21.90	45.9	39.36

SOLUBILITY OF MERCURIC CHLORIDE IN MIXTURES OF METHYL ALCOHOL AND BENZENE AT DIFFERENT TEMPERATURES.

(Timofeiew, 1894.)

Cl

In a Mixture of one mol. CH_3OH + one mol. C_6H_6 .		In a Mixture of one mol. CH_3OH + two mols. C_6H_6 .	
t°.	Gms. HgCl_2 per 100 Gms. Sat. Sol.	t°.	Gms. HgCl_2 per 100 Gms. Sat. Sol.
0	8	0	4.8
21-25	23.9	21-25	17.1
30	27.3	30	18
37	28.1	37	18.4

SOLUBILITY OF MERCURIC CHLORIDE IN BENZENE, IN DICHLORETHANE AND IN ETHYLACETATE AT DIFFERENT TEMPERATURES.

(Dukelski, 1907.)

In C_6H_6 .		In $\text{C}_2\text{H}_4\text{Cl}_2$.		In $\text{CH}_3\text{COOC}_2\text{H}_5$.	
t°.	Gms. HgCl_2 per 100 Gms. Sat. Sol.	t°.	Gms. HgCl_2 per 100 Gms. Sat. Sol.	t°.	Gms. HgCl_2 per 100 Gms. Sat. Sol.
6.5	0.26	0	1.33	0	22.9
18	0.53	12.5	1.55	6.5	22.7
34.1	0.64	25.3	1.73	26.1	22.8
54.1	1.02	33	2.05	38.5	23.5
69	1.39	45.9	2.42	45.3	26.4

SOLUBILITY OF MERCURIC CHLORIDE IN MIXTURES OF BENZENE AND ETHYL-ACETATE, CHLOROFORM AND ETHYL ACETATE AND OF CARBON TETRACHLORIDE AND ETHYL ACETATE.

(Dukelski, 1907.)

In a Mixture of one mol. C_6H_6 + one mol. $\text{CH}_3\text{COOC}_2\text{H}_5$.		In a Mixture of one mol. CHCl_3 + one mol. $\text{CH}_3\text{COOC}_2\text{H}_5$.		In a Mixture of one mol. CCl_4 + two mols. $\text{CH}_3\text{COOC}_2\text{H}_5$.	
t°.	Gms. HgCl_2 per 100 Gms. Sat. Sol.	t°.	Gms. HgCl_2 per 100 Gms. Sat. Sol.	t°.	Gms. HgCl_2 per 100 Gms. Sat. Sol.
0	9.62	0	3.34	0	9.24
6.5	9.62	26.1	4.07	10.3	9.05
25.7	9.78	36.1	4.78	25.7	9.32
27.6	9.98	46	5.38	27.6	9.50
35.5	10.81	48.5	5.10	38.5	9.89
45.3	13.69			45.3	11.70

SOLUBILITY OF MERCURIC CHLORIDE IN ETHYL ACETATE AND IN
ACETONE.

(Etard, 1894; von Laszcynski, 1894; Krug and McElroy, 1892; Linebarger, 1894; Aten, 1905-06.)

NOTE. — The results obtained by the above-named investigators were calculated to a common basis and plotted on cross-section paper. The variations which were noted could not be satisfactorily harmonized, consequently all the results are included in the following table:

SOLUBILITY.

In Ethyl Acetate.					In Acetone.			
t°.	Grams HgCl ₂ per 100 Grams Solution.				Gms. HgCl ₂ per 100 Gms. Solution.			
	Laszcynski.	Aten.	Linebarger.	Etard.	K and McE.	Laszcynski.	Aten.	Etard.
—10	...	23.0	...	40	...	...	44.0 *	57.0
0	22.0	23.2	32.0	40	...	49.7	43.0 *	61.7
+10	22.2	23.5	32.5	40	...	52.0	51.0 *—58.9 †	61.7
20	22.5	23.4	32.7	40	...	54	58.5 †	61.7
25	22.7	23.5	33.0	40	37.4	55.2	58.2 †	61.7
30	23.0	...	33.2	40	...	...	...	61.7
40	23.5	...	33.5	40	...	...	...	61.7
50	24.0	...	33.5	41	...	...	...	61.7
60	24.7	...	...	42.5	...	...	...	61.7
80	26.0	...	...	45.2	...	...	...	61.7
100	...	...	...	48.0	...	...	...	...
120	...	...	...	50.8	...	...	...	...
150	...	...	...	55.0	...	...	...	...

(*) Solid phase HgCl₂(CH₃)₂CO.

(†) Solid Phase HgCl₂.

100 gms. absolute acetone dissolve 143 gms. HgCl₂ at 18°. (Naumann, 1904.)

100 gms. sat. solution of HgCl₂ in Acetone contain 54.9 gms. HgCl₂ at 25°. (Zapata y Zapata, 1930.)

100 gms. ethyl acetate ($d_{44} = 0.8995$) dissolve 48.8 gms. HgCl₂ at 18°.

(Naumann, 1910.)

100 gms. methyl acetate ($d_{44} = 0.935$) dissolve 42.6 gms. HgCl₂ at 18°.

(Naumann, 1909.)

SOLUBILITY OF MERCURIC CHLORIDE IN SEVERAL SOLVENTS.

(Arctowski, 1891; von Laszcynski, 1894; Sulc, 1900.)

In Carbon Bisulphide (A.).		In Benzene (von L.).		In Several Solvents at 18–20° (S.).	
t°.	Gms. HgCl ₂ per 100 Gms. Solution.	t°.	Gms. HgCl ₂ per 100 Gms. Solution.	Solvent.	Gms. HgCl ₂ per 100 Gms. Solvent.
—10	0.010	15	0.537	CHBr ₃	0.486
0	0.018	41	0.616	CHCl ₃	0.106
10	0.026	55	0.843	CCl ₄	0.002
15	0.032	84	1.769	C ₂ H ₅ Br	2.010
20	0.042			C ₂ H ₄ Br ₂	1.530
25	0.053				
30	0.063				

Hg HYDRARGYRUM

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SOLUBILITY OF MERCURIC CHLORIDE IN MIXTURES OF ACETONE AND BENZENE, ETHER AND CHLOROFORM AND OF ETHYL ACETATE AND BENZENE AT 25°.
(Marden and Dover, 1917.)

In Mixtures of $\text{CH}_3\text{COCH}_3 + \text{C}_6\text{H}_6$.		In Mixtures of $(\text{C}_2\text{H}_5)_2\text{O} + \text{CHCl}_3$.		In Mixtures of $\text{CH}_3\text{COOC}_2\text{H}_5 + \text{C}_6\text{H}_6$.	
Gms. CH_3COCH_3 per 100 Gms. Mixture.	Gms. HgCl_2 per 100 Gms. Mixed Solvent.	Gms. CHCl_3 per 100 Gms. Mixture.	Gms. HgCl_2 per 100 Gms. Mixed Solvent.	Gms. $\text{CH}_3\text{COOC}_2\text{H}_5$ per 100 Gms. Mixture.	Gms. HgCl_2 per 100 Gms. Mixed Solvent.
100	140	0	6.95	100	49.3
90	117	10	5.85	90	26
80	96.5	20	4.73	80	22.1
70	77	30	3.70	70	18.1
60	60	40	2.80	60	14.2
50	45	50	2.10	50	11
40	31.4	60	1.48	40	8
30	20	70	0.95	30	5.4
20	10.7	80	0.657	20	3.1
10	3.9	90	0.328	10	1.6
0	0.66	100	0.128	0	0.66

SOLUBILITY OF MERCURIC CHLORIDE IN BENZENE.

(Average curve from results of Linebarger, 1895; Sherrill, 1903; and Marden and Dover, 1917.)

C1

t°.	Gms. HgCl_2 per 100 Gms. C_6H_6 .	t°.	Gms. HgCl_2 per 100 Gms. C_6H_6 .
0	0.20	25	0.64
10	0.39	30	0.71
20	0.56	40	0.84

SOLUBILITY OF MERCURIC CHLORIDE IN ABSOLUTE ETHYL ETHER.

(Etard, 1894; Laszcynski, 1894; Köhler, 1879.)

t°.	Gms. HgCl_2 per 100 Gms. Solution.	t°.	Gms. HgCl_2 per 100 Gms. Solution.	t°.	Gms. HgCl_2 per 100 Gms. Solution.
-20	6	60	6	90	7.5
0	6	70	6.4	100	8
20	6	80	7	110	8.5

SOLUBILITY OF MERCURIC CHLORIDE IN CHLORINATED HYDROCARBONS AT 25°.

(Hoffmann, Kirmreuther and Thal, 1910.)

Solvent.	Formula.	Gms. HgCl_2 per 100 Gms. Solvent.	Solvent.	Formula.	Gms. HgCl_2 per 100 Gms. Solvent.
Ethylene Chloride	$\text{CH}_2\text{Cl}.\text{CH}_2\text{Cl}$	1.229	Dichlorethylene	$\text{CHCl}.\text{CHCl}$	0.114
Tetrachlorethane	$\text{C}_2\text{H}_2\text{Cl}_4$	0.090	Trichlorethylene	$\text{CHCl}.\text{CCl}_2$	0.0274
Chloroform	CHCl_3	0.101	Tetrachlorethylene	$\text{CCl}_2.\text{CCl}_2$	0.0072
Pentachlorethane	C_2HCl_5	0.0193	Carbontetrachloride	CCl_4	trace

100 gms. 95% formic acid dissolve 2.1 gm. HgCl_2 at 19°. (Aschan, 1913.)

100 gms. 95% formic acid dissolve 0.02 gm. Hg_2Cl_2 at 16.5°.

100 cc. anhydrous hydrazine dissolve 1 gm. Hg_2Cl_2 with decomp. at room temp. (Welsh and Broderson, 1915.)

100 cc. anhydrous hydrazine dissolve 1 gm. Hg_2Cl_2 with decomp. at room temp. (Welsh and Broderson, 1915.)

100 gms. glycerol dissolve 80 gms. HgCl_2 at 25°. (Moles and Marquina, 1914.)

100 gms. glycerol dissolve 8 gms. HgCl_2 ? Hg_2Cl_2 at 15-16°. (Ossendowski, 1907.)

100 gms. anhydrous lanolin (m. pt. about 46°) dissolve 1.55 gms. HgCl_2 at 45°. (Klose, 1907.)

100 gms. sat. solution of HgCl_2 in Ethyl Ether contain 6.494 gms. HgCl_2 at about 20°. (Richard, 1926.)

SOLUBILITY OF MERCURIC CHLORIDE IN PYRIDINE.
(McBride, 1910.)

The determinations at the lower temperatures were made by stirring an excess of HgCl_2 with pyridine and analyzing the sat. solution. Those at the higher temperatures were made by the synthetic method.

t°.	Gms. HgCl_2 per 100 Gms. Sat. Sol.	Solid Phase.	t°.	Gms. HgCl_2 per 100 Gms. Sat. Sol.	Solid Phase.
-32.6	2.76	$\text{HgCl}_2 \cdot 2\text{C}_5\text{H}_5\text{N}$	94.7	60.72	$\text{HgCl}_2 \cdot 2\text{C}_5\text{H}_5\text{N} + 3\text{HgCl}_2 \cdot 2\text{C}_5\text{H}_5\text{N}$
-21.75	7.86	"	74.7	48.38	$\text{HgCl}_2 \cdot \text{C}_5\text{H}_5\text{N}$ (unstable)
0.02	13.14	"	83.5	50.53	" (stable)
12.58	17.34	"	90.4	53.41	"
18.78	19.78	"	97	56.45	"
27.23	22.65	"	100.5	57.84	"
31.05	24.46	"	104.2	60.72	"
40.90	29.29	"	107	63.06	" (unstable)
50.10	34.94	"	106.2	...	" $+ 3\text{HgCl}_2 \cdot 2\text{C}_5\text{H}_5\text{N}$
60.03	40.36	"	95.2	60.77	$3\text{HgCl}_2 \cdot 2\text{C}_5\text{H}_5\text{N}$ (unstable)
70.15	46.44	"	106.4	61.93	" (stable)
76	...	" $+ \text{HgCl}_2 \cdot \text{C}_5\text{H}_5\text{N}$	109.8	62.58	"
80.02	51.52	$\text{HgCl}_2 \cdot 2\text{C}_5\text{H}_5\text{N}$ (unstable)	114	63.18	"
89	56.45	"	124.2	65	"
94.1	60.09	"	145.5	69.66	"

Data for this system are also given by Staronka (1910).

Data for the solubility of $\text{HgCl}_2 \cdot 2\text{C}_5\text{H}_5\text{N}$ and of $\text{Hg}(\text{NO}_3)_2 \cdot 2\text{C}_5\text{H}_5\text{N} \cdot 2\text{H}_2\text{O}$ in aqueous solution of pyridine at 18° are given by Strömholm (1908).

Data for the solubility of diamine mercuric chloride, $(\text{NH}_3)_2\text{HgCl}_2 - \text{NH}_2\text{HgCl}$, in aqueous solutions of ammonia at 17.5° are given by Strömholm (1908).

Cl

(SOLUBILITY OF MERCURIC CHLORIDE AND OF DOUBLE MERCURIC AND
TETRA METHYL AMINE CHLORIDE $(\text{CH}_3)_4\text{NCl} \cdot 6\text{HgCl}_2$ IN AQ. ETHER
AT 17°. (Strömholm — J. pr. Ch. [2] 66, 443, '02; Z. physik. Chem. 44, 64, '03.)

Molecular Concentration per Liter.			Grams per Liter of Solution.		
H_2O .	HgCl_2 (*).	HgCl_2 (†).	H_2O .	HgCl_2 (*).	HgCl_2 (†).
0.0	0.1515	0.0342	0	41.16	9.26
0.0656	0.1795	0.0428	1.18	48.64	11.60
0.1311	0.2069	0.0516	2.36	56.08	14.00
0.1956	0.2339	0.0603	3.52	63.38	16.34
0.2611	0.2489	0.0690	4.70	70.16	18.70
0.3267	0.2849	0.0779	5.88	77.20	21.10
0.3922	0.3100	0.0866	7.06	84.02	23.48

(*) Results in this column are for solutions in contact with the Solid Phase HgCl_2 . (†) Results in this column are for solutions in contact with the Solid Phase $(\text{CH}_3)_4\text{NCl} \cdot 6\text{HgCl}_2$.

SOLUBILITY OF MERCURIC CHLORIDE AND OF DOUBLE MERCURIC AND
TETRA METHYL AMINE CHLORIDE IN ALCOHOL-ETHER SOLUTIONS
AT 17°. (Strömholm.)

Grams $\text{C}_2\text{H}_5\text{OH}$ per Liter.	Grams HgCl_2 (*) per Liter.	Grams HgCl_2 (†) per Liter.
0.0	41.16	9.26
4.58	50.00	11.87
9.16	58.76	14.38
13.74	66.96	16.90

SOLUBILITY OF DOUBLE MERCURIC CHLORIDES IN AQUEOUS AND PURE ETHER AT 16.6°.

(Strömholm, 1902, 1903.)

Mol. Conc. of HgCl ₂ per Liter of:				Gms. HgCl ₂ per Liter of:				Solid Phase.
Pure Ether.	Aq. Ether (1).	Aq. Ether (2).	Aq. Ether (3).	Pure Ether.	Aq. Ether (4).	Aq. Ether (5).	Aq. Ether (6).	
0.1515	0.2387	0.2647	0.3196	41.04	64.69	71.71	86.58	HgCl ₂
0.0673	0.1157	0.1293	0.1617	18.23	31.41	35.05	43.79	(CH ₃ .C ₂ H ₅ .C ₂ H ₅) ₂ .SCL.6HgCl ₂
0.0404	0.0720	0.0835	0.1034	10.95	19.51	22.61	28.01	(CH ₃ .C ₂ H ₅ .C ₂ H ₅) ₂ .SCL.6HgCl ₂
0.0342	...	0.0706	...	9.26	...	19.10	...	(CH ₃) ₄ .NCL.6HgCl ₂
0.0264	...	0.0568	...	7.14	...	15.39	...	(C ₂ H ₅) ₃ .SCL.6HgCl ₂
0.0209	0.0400	0.0460	0.0594	5.66	10.83	12.48	16.10	(CH ₃ .C ₂ H ₅) ₂ .SCL.6HgCl ₂
0.0063	...	0.0144	...	1.70	...	3.90	...	(CH ₃) ₂ .H ₂ NCL.2HgCl ₂

(1) containing 0.21055 mol. H₂O per liter. (2) 0.2756 mol. H₂O per liter. (3) 0.421 mol. H₂O per liter. (4) containing 3.79 gms. H₂O per liter. (5) 4.97 gms. H₂O per liter. (6) 7.59 gms. H₂O per liter.

SOLUBILITY OF MIXTURES OF MERCURIC AND POTASSIUM CHLORIDES AT 25° IN:

Absolute Alcohol. (Foote, 1910.)

Acetone. (Foote, 1910.)

Gms. per 100 Gms. Sat. Solution.		Solid Phase.	Gms. per 100 Gms. Sat. Solution.		Solid Phase.
KCl.	HgCl ₂ .		KCl.	HgCl ₂ .	
0.21	33.69	HgCl ₂ + 5KCl.6HgCl ₂ .2C ₂ H ₅ OH	1.27	61.87	HgCl ₂ + KCl.5HgCl ₂ .(CH ₃) ₂ CO
0.28	33.80	"	1.39	60.68	KCl.5HgCl ₂ .(CH ₃) ₂ CO
0.22	24.84	5KCl.6HgCl ₂ .2C ₂ H ₅ OH	2.58	55.85	"
0.28	6.21	"	2.78	54.41	" + 5.6.2
0.25	1.65	5KCl.6HgCl ₂ .2C ₂ H ₅ OH + KCl	2.93	48.13	5.6.2
0.17	1.57	"	2.52	18.04	"
0.38	1.03	"	3.34	13.26	"
			2.92	11	" + KCl

5.6.2 = 5KCl.6HgCl₂.2(CH₃)₂CO.

100 gms. of sat. abs. alcohol solution of HgCl₂ + NaCl contain 46.85 gms. HgCl₂ and 3.01 gms. NaCl at 25°.

(Foote, 1910.)

SOLUBILITY OF MERCURIC CHLORIDE AND SODIUM CHLORIDE IN ETHYL ACETATE AT 40°.

(Linebarger — Am. Ch. J. 16, 214, '94.)

Mols. per 100 Mols. Acetate.		Gms. per 100 Gms. Acetate.		Gms. per 100 Gms. Solution.		Solid Phase.
NaCl.	HgCl ₂ .	NaCl.	HgCl ₂ .	NaCl.	HgCl ₂ .	
0.8	12.9	0.53	39.7	0.53	28.4	HgCl ₂
2.3	12.4	1.53	38.15	1.51	27.61	"
4.3	16.4	2.85	50.44	2.78	33.54	"
9.1	22.85	6.05	86.14	5.60	46.28	"
18.5	34.9	12.29	107.4	10.95	51.76	"
20.0	40.0	13.29	123.0	11.73	55.18	HgCl ₂ + NaCl

The double salt (HgCl₂)₂.NaCl is formed under proper conditions.

FREEZING-POINT DATA ARE GIVEN FOR THE FOLLOWING MIXTURES.

Mercuric Chloride + Mercuric Iodide	(Padoa and Tibaldi, 1903; Losana, 1926; Bergmann and Gonke, 1926.)
" " + Mercuric Sulfate	(Paic, 1930, 1933.)
" " + Lead Chloride	(Van Driel, 1935.)
" " + Ammonium Chloride	(Jänecke, 1923.)
" " + Silver Nitrate	(Bergmann, 1926.)
" " + Thallium Nitrate	" "
" " + Thallium Sulfate	(Waskresenskaja, 1929.)
" " + Selenium	(Olivari, 1909.)
" " + Antimony Chloride	(Kendall, Crittenden and Miller, 1923.)
" " + Sulfur	(Olivari, 1909.)
" " + Nitrobenzene	(Mascarelli, 1906; Mascarelli and Ascoli, 1907.)
" " + <i>o</i> and <i>p</i> Nitrotoluene	(Mascarelli, 1906, 1907, 1909.)
" " + Urethan	(Mascarelli, 1908, 1909.)
" " + " + Nitronaphthalene	(" 1906, 1907.)
" " + " + <i>p</i> Nitrotoluene	(" 1908.)
" " + α Nitronaphthalene	(" 1906, 1907.)
" " + <i>p</i> Nitranisole	(" 1906.)

MERCUROUS PER CHLORATE $\text{Hg}_2(\text{ClO}_4)_2$

SOLUBILITY OF MERCUROUS PER CHLORATE IN WATER.

(Newbery, 1936.)

t°	Gms. $\text{Hg}_2(\text{ClO}_4)_2$ per 100 gms. H_2O	Solid Phase	t°	Gms. $\text{Hg}_2(\text{ClO}_4)_2$ per 100 gms. H_2O	Solid Phase
-20	215	$\text{Hg}_2(\text{ClO}_4)_2 \cdot 4\text{H}_2\text{O}$	37	455	$\text{Hg}(\text{ClO}_4)_2 \cdot 2\text{H}_2\text{O}$
0	282	"	38	455	"
+ 8	315	"	40	457	"
17	355	"	50	480	"
20 ($d = 2.960$)	368	"	60	500	"
30	420	"	70	516	"
35	450	"	78	536	"
36	465	" + $\text{Hg}(\text{ClO}_4)_2 \cdot 2\text{H}_2\text{O}$	99	580	"

SOLUBILITY OF MERCUROUS PER CHLORATE IN AQUEOUS SOLUTIONS OF PERCHLORIC ACID AT 21° .

(Newbery, 1936.)

Mols. free HClO_4 per 100 gms. H_2O	Gms. $\text{Hg}_2(\text{ClO}_4)_2$ per 100 gms. H_2O	Solid Phase
0.10	375	$\text{Hg}_2(\text{ClO}_4)_2 \cdot 4\text{H}_2\text{O}$
0.38	300	"
0.46	280	"
1.27	21.2	$\text{Hg}_2(\text{ClO}_4)_2 \cdot 2\text{H}_2\text{O}$
1.29	13.7	"

The total gm. mols. of HClO_4 in the above solutions is nearly constant; hence each added gm. mol. of HClO_4 precipitate approximately one gm. mol. equivalent of the salt..

Hg HYDRARGYRUM

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MERCUROUS CHROMATE Hg_2CrO_4

The Solubility Product of Mercurous Chromate in Water at 25° is 2.0×10^{-9} as quoted from Immerwahr by Brodsky, 1929.

MERCUROUS Phospho FLUORIDE $\text{Hg}_2\text{PO}_3\text{F}$

F One liter sat. solution of Mercury Phospho Fluoride in Water contains about 0.0005 gm. mols. (= 0.025 gm.) $\text{Hg}_2\text{PO}_3\text{F}$ at 20°. (Lange, 1929.)

MERCUROUS IODIDE Hg_2I_2

SOLUBILITY OF MERCUROUS IODIDE IN WATER AT 25°. (Sherrill, 1903.)

One liter sat. solution contains 2×10^{-7} gms. Hg_2I_2 , determined by indirect method.

Data for the solubility of mercurous iodide in aq. KI solutions at 25° are also given by Sherrill.

The Solubility Product of Mercurous Iodide in Water, calculated from measurements of the E.M.F. of a chain electrode by Brodsky, 1929, is as follows:

t°	Solubility Product
10.8	2.01×10^{-20}
14.9	5.10×10^{-20}
19.2	10.5×10^{-20}
25.0	49.5×10^{-20}
26.5	74.2×10^{-20}

I MERCURIC IODIDE HgI_2

SOLUBILITY OF MERCURIC IODIDE IN WATER.

t°	Gms. HgI_2 per liter	Authority
17.5	0.040	(Bourgoin, 1884.)
22.	0.054	(Rohland, 1898.)
22.5	0.001	(Naude, 1927.)
25.	0.059	(Morse, 1902.)

SOLUBILITY OF MERCURIC IODIDE IN WATER AT TEMPERATURES

ABOVE 100° DETERMINED BY THE SYNTHETIC METHOD.

(Benrath, Qjedebo, Schiffers and Wunderlich, 1937.)

At 11.5 percent concentration of HgI_2 and temperature of 241° the mixture separates into two liquid layers, composed of a yellow solution and a wine red melt. These two layers mutually dissolve with rising temperature. At 77 percent HgI_2 and 338° the solution and melt become identical and mix in all proportions above that temperature.

t°	Gms. HgI_2 per 100 gms. sat. sol.	Solid Phase	t°	Gms. HgI_2 per 100 gms. sat. sol.	t°	Gms. HgI_2 per 100 gms. sat. sol.
196	3.7	HgI_2	243	12.0	328	54.4
229	9.4	"	257	15.7	336	68.0
241	11.5	"	272	18.7	338	75.0
241	98.0	"	295	27.5	336	82.7
255	100.0	"	314	41.0	322	90.5
			326	49.7	262	97.4

SOLUBILITY OF MERCURIC IODIDE IN AQUEOUS SOLUTIONS AT 25°.

(Herz and Paul, 1913.)

In Aq. BaI ₂ .		In Aq. CaI ₂ .		In Aq. NaI.		In Aq. SrI ₂ .	
Mols. per Liter.		Mols. per Liter.		Mols. per Liter.		Mols. per Liter.	
BaI ₂ .	HgI ₂ .	CaI ₂ .	HgI ₂ .	NaI.	HgI ₂ .	SrI ₂ .	HgI ₂ .
0.099	0.059	0.053	0.050	0.794	0.412	0.254	0.212
0.748	0.742	0.252	0.261	1.385	0.622	0.355	0.320
0.978	0.897	0.468	0.440	2.225	0.945	0.539	0.582
1.508	1.462	1.799	1.706			0.608	0.694

SOLUBILITY OF MERCURIC IODIDE IN AQUEOUS SOLUTIONS OF POTASSIUM IODIDE AT 25° (Sherrill, 1903; Herz and Paul, 1913.)

Mols. per Liter.		Gms. per Liter.		Mols. per Liter.		Gms. per Liter.	
KI.	HgI ₂ .	KI.	HgI ₂ .	KI.	HgI ₂ .	KI.	HgI ₂ .
0.05	0.025	8.3	11.4	1	0.50	166	227.2
0.10	0.05	16.6	22.7	1.5	0.75	249	340.8
0.20	0.10	33.2	45.4	2	1	332	454.5
0.50	0.25	83	113.6	2.5	1.25	415	578

Data for the distribution of mercuric iodide between aq. KI solutions and benzene at 25° are given by Sherrill, 1903.

EQUILIBRIUM IN THE TERNARY SYSTEM MERCURIC IODIDE, POTASSIUM IODIDE, WATER AT 20° AND 30°. (Dunningham 1914.)

Results at 20°.			Results at 30°.		
Gms. per 100	Gms. Sat. Sol.	Solid Phase.	Gms. per 100	Gms. Sat. Sol.	Solid Phase.
KI.	HgI ₂ .		KI.	HgI ₂ .	
50.9	19.3	KI	60.6	...	KI
44.4	32.4	"	40	53	" + KHgI ₂
39	48	"	39.6	52.7	KHgI ₂
37.4	53.6	" + KHgI ₂	40	52.2	"
37.8	52.6	KHgI ₂	40.2	51.2	"
35.1	52.2	"	39.3	50.3	"
35.5	51.2	KHgI ₂ .H ₂ O	33.7	49.8	"
26.7	50.3	" + HgI ₂	33	52	"
26.6	49.4	HgI ₂	31.4	51.7	KHgI ₂ .H ₂ O
23.7	40.2	"	29.1	52.2	"
14.9	22.5	"			

EQUILIBRIUM IN THE SYSTEM MERCURIC IODIDE, POTASSIUM IODIDE AND WATER AT 22.5°.

(Naude, 1927.)

The solutions were analyzed by reducing the mercury and converting the iodine to KI by adding KOH and C₂H₅OH and warming. The total KI in the filtrate from the Hg was titrated with standard solutions of AgNO₃ and KSCN.

Gms. per 100		Solid	Gms. per 100		Solid	Gms. per 100		Solid
gms. sat. sol.			gms. sat. sol.			gms. sat. sol.		
KI	HgI ₂	Phase	KI	HgI ₂	Phase	KI	HgI ₂	Phase
0.0	0.01	HgI ₂	29.18	49.18	1.1.1½	34.84	51.53	1.1
1.95	2.02	"	31.18	49.28	"	36.45	51.28	KI
16.16	10.96	"	32.68	49.15	"	36.69	50.01	"
24.60	45.06	"	33.37	49.67	"	37.61	47.04	"
24.57	46.93	"	33.92	50.10	"	40.41	37.41	"
25.10	49.13	" + 1.1.1½	33.79	51.13	"	49.60	18.37	"
27.58	49.06	1.1.1½	34.04	51.74	1.1	58.33	1.60	"
28.44	48.97	"	34.92	51.58	"	59.20	0.0	"

1.1.1½ = HgI₂.KI.1½H₂O; 1.1 = HgI₂.KI

MERCURIC IODIDE HgI_2 EQUILIBRIUM IN THE SYSTEM MERCURIC IODIDE POTASSIUM
IODIDE AND WATER AT SEVERAL TEMPERATURES.

(Pernot, 1926, 1927, 1931.)

The samples were analyzed by separating the HgI_2 from the KI by sublimation in a glass tube which could subsequently be cut and the amount of each component determined by weighing. The accuracy of the results of Dunningham, 1914, is questioned.

Results at 0°			Results at 10°			Results at 20°		
Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase
HgI_2	KI		HgI_2	KI		HgI_2	KI	
19.1	13.3	HgI_2	19.6	12.0	HgI_2	10.3	7.4	HgI_2
32.7	21.1	"	34.9	22.0	"	24.3	16.2	"
39.9	25.0	"	41.7	25.5	"	34.7	21.3	"
41.8	26.7	1.1.1	44.8	27.0	1.1.1	41.3	24.6	"
43.3	29.7	"	46.6	30.7	"	48.2	27.3	" + 1.1.1
45.5	32.1	"	48.1	33.7	"	48.0	29.0	1.1.1
47.8	34.8	"	49.3	35.7	"	48.7	31.3	"
50.2	37.5	"	50.8	37.5	"	49.2	33.4	"
47.5	38.1	KI	50.9	37.9	" + KI	49.9	34.9	"
43.7	38.9	"	48.1	38.3	KI	50.9	36.8	"
39.2	40.0	"	46.5	38.6	"	50.0	37.9	KI
34.0	41.9	"	44.7	39.0	"	45.3	39.1	"
28.4	43.9	"	38.2	41.2	"	31.0	44.4	"
24.1	45.6	"	35.7	42.3	"	16.7	50.6	"
19.3	47.4	"				8.7	53.8	"
15.6	49.2	"						
Results at 34°			Results at 56°			Results at 80°		
3.1	2.2	HgI_2	4.1	3.2	HgI_2	1.2	0.6	HgI_2
20.3	12.9	"	27.4	16.6	"	19.1	11.3	"
47.4	26.2	"	46.1	25.0	"	40.8	20.9	"
53.4	27.7	" + 1.1.1	57.1	27.5	"	54.3	24.6	"
52.4	29.3	1.1.1	57.4	28.8	1.1.1	65.0	26.2	" + 1.1.1
51.9	30.7	"	56.4	30.2	"	63.2	27.6	1.1.1
51.7	34.4	"	54.9	32.8	"	61.1	29.4	"
52.5	37.6	" + KI	54.2	37.5	" + KI	58.2	33.0	"
49.8	38.3	KI	53.0	37.9	KI	57.5	36.2	" + KI
40.1	39.3	"	46.6	39.8	"	56.7	36.6	KI
42.3	40.5	"	41.2	42.0	"	46.5	40.4	"
33.7	44.2	"	24.7	49.4	"	28.9	48.3	"
15.6	52.9	"	12.8	56.1	"	15.5	56.2	"
			3.9	61.4	"	8.0	60.8	"

1.1.1 = $\text{HgI}_2 \cdot \text{KI} \cdot \text{H}_2\text{O}$. No evidence was obtained of the existence of the compound $\text{HgI}_2 \cdot \text{KI}$.

EQUILIBRIUM IN THE SYSTEM MERCURIC IODIDE, POTASSIUM IODIDE
AND ETHYL ALCOHOL AT 40°.

(Permut, 1931.)

Results using Absolute Alcohol			Results using 95% Alcohol		
Ans. per 100 gms. sat. sol.	Solid	Phase	Ans. per 100 gms. sat. sol.	Solid	Phase
HgI ₂	KI		HgI ₂	KI	
49.7	14.6	HgI ₂	16.9	4.4	HgI ₂
53.6	18.1	"	41.9	11.6	"
58.8	18.7	" + HgI ₂ ·KI·2H ₂ O	54.2	19.7	"
57.0	19.8	HgI ₂ ·KI·2H ₂ O	58.2	18.4	" + HgI ₂ ·KI·H ₂ O
54.8	20.9	"	57.0	19.0	HgI ₂ ·KI·H ₂ O
52.7	23.2	"	55.6	20.4	"
51.7	24.5	"	54.0	21.4	"
51.4	25.7	"	53.4	20.9	"
50.4	26.4	KI	50.2	22.0	KI
47.7	27.7	"	20.6	15.4	"
			4.3	6.2	"

EQUILIBRIUM IN THE SYSTEM MERCURIC IODIDE, POTASSIUM IODIDE
AND ANHYDROUS ACETONE AT 20°.

(Permut, 1926, 1929, 1931.)

Ans. per 100 gms. sat. sol.	Solid		Ans. per 100 gms. sat. sol.	Solid	
HgI ₂	KI	Phase	HgI ₂	KI	Phase
47.4	8.4	HgI ₂	65.9	24.0	1.1.1/3-1/4
50.5	14.6	"	64.4	24.9	"
65.8	18.1	"	64.2	24.6	" + KI
66.4	19.6	"	62.9	22.0	KI
66.4	20.4	" + 1.1.1/3-1/4	64.9	22.6	"
67.9	20.7	1.1.1/3-1/4	64.4	20.9	"

1.1.1/3-1/4 = HgI₂·KI·1/3 or 1/4 H₂O/2H₂O.

The author also gives determinations of the equilibrium in acetone containing 2 Vol. % H₂O and 4 Vol. % H₂O, at 20°, 40° and 50°. Great difficulty was experienced in obtaining homogeneous crystals of the double salts. By using different methods of obtaining saturation it was found that in acetone containing 4 Vol. % H₂O the only double salt obtained was HgI₂·KI·H₂O. In acetone containing 2 Vol. % H₂O the double salt 2HgI₂·KI was obtained only at 50°. The salt HgI₂·2KI was obtained at 50° and at 40° but not at 20°. The only other double salt found was HgI₂·KI.

100 gms. sat. solution of Mercuric Iodide in Acetone contain 4.08 gms. HgI₂ at 25°. (Zapata y Zapata, 1930.)

SOLUBILITY OF MERCURIC IODIDE IN ANHYDROUS ACETIC ACID
DETERMINED BY THE GASTRICH METHOD.

(Gastreich and Chappell, 1930.)

100	Moie. HgI ₂ per 100	Solid	100	Moie. HgI ₂ per 100	Solid
moie. HgI ₂ = CH ₃ COOH	Phase		moie. HgI ₂ = CH ₃ COOH	Phase	

EQUILIBRIUM IN THE TERNARY SYSTEM MERCURIC IODIDE, POTASSIUM IODIDE, ETHYL ETHER AT 20°. (Dunningham, 1914.)

Two liquid layers with compositions as follows, are formed:

Gms. per 100 Gms. Upper Layer.		Gms. per 100 Gms. Lower Layer.		Solid Phase.
KI.	HgI ₂ .	KI.	HgI ₂ .	
I. I	2.8	None		KI+KHgI ₂
I. I	2.4	17.6	53.2	KHgI ₂
0.8	2.5	16.5	56.1	HgI ₂
None		17	58.2	KHgI ₂ +HgI ₂

Data are also given for the four component system, HgI₂ + KI + (C₂H₅)₂O + H₂O at 20°. The results are of special interest since 3 liquid layers are formed.

SOLUBILITY OF MERCURIC IODIDE IN AQUEOUS ETHYL ALCOHOL:

At 18°.		At 25°.			
(Bourgoin.)		(Herz and Knoch — Z. anorg. Ch. 45, 266, '05.)			
Solvent.	Gms. HgI ₂ per Liter.	Wt. % Alcohol in Solvent.	HgI ₂ per 100 cc. Solution. Millimols.	Grams.	Sp. Gr. of Solutions 25°/4°
Abs. Alcohol	11.86	100	3.86	1.754	0.8033
H ₂ O + 80% 90° Alc.	2.857	95.82	2.56	1.162	0.8095
H ₂ O + 10% 90° Alc.	0.086	92.44	1.92	0.873	0.8154
		86.74	1.38	0.623	0.8300
		78.75	0.935	0.425	0.8405
		67.63	0.45	0.204	0.8721

SOLUBILITY OF MERCURIC IODIDE IN AQUEOUS METHYL ALCOHOL AND IN AQUEOUS ETHYL ACETATE AT 25°. (Herz and Anders, 1907.)

In Aq. Methyl Alcohol.				In Aq. Ethyl Acetate.			
Wt. % CH ₃ OH in Solvent.	d ₂₅ of Solvent.	d ₂₅ of Sat. Sol.	Gms. HgI ₂ per 100 cc. Sat. Sol.	Wt. % CH ₃ COOC ₂ H ₅ in Solvent.	d ₂₅ of Sat. Sol.	Gms. HgI ₂ per 100 cc. Sat. Sol.	
47.06	0.9186	0.9187	0.044	4.36	0.9973	0.013	
64	0.8800	0.8834	0.158	96.74	0.9063	1.87	
78.05	0.8489	0.8519	0.445	100	0.9011	1.09	
100	0.7879	0.8155	2.590				

100 gms. sat. solution in 95% alcohol ($d_{15} = 0.8126$) contain 0.72 gm. HgI₂ at 0°, 1.06 gms. at 25° and 2.15 gms. at 50°. (Reinders, 1900.)

MERCURY IODIDE (ic) HgI₂.SOLUBILITY OF MERCURIC IODIDE IN METHYLAL (H CH (O CH₃)₂). (Bourgoin, 1924.)

The methylal was purified by distillation over sodium. At the lower temperatures the solutions were saturated by constant agitation. At the higher temperatures the synthetic method was used.

t°.	Gms. HgI ₂ per 100 gms. sat. sol.	Solid Phase.	t°.	Gms. HgI ₂ per 100 gms. sat. sol.	Solid Phase.
20.....	3.81	HgI ₂ (red)	74.....	5.80	HgI ₂ (red)
25.....	4.07	»	77.....	5.93	»
30.....	4.19	»	81.....	6.05	»
53.....	4.56	»	123.....	7.89	»
63.....	5.12	»	125 (tr. pt.).	7.96	»+ HgI ₂ (yellow)
67.....	5.32	»	136.5.....	8.00	HgI ₂ (yellow)
71.....	5.56	»	166.....	8.14	»

SOLUBILITY OF MERCURIC IODIDE IN ALCOHOLS.

Alcohol.	Formula.	t°.	Sp. Gr. of Solution.	Gms. HgI ₂ per 100 Gms. Alcohol.	Observer.
Methyl	CH ₃ OH	15-20	0.799	3.24	(Rohland.)
"	"	19	...	3.7	(Timofeiew.)
"	"	19.5	...	3.16	(de Bruyn.)
"	"	23	...	3.98	(Beckmann.)
"	"	66 (b. pt.)	...	6.512	(Sulc.)
Ethyl	C ₂ H ₅ OH	15-20	0.810	1.42	(Rohland.)
"	"	18	...	1.48	(Bourgoin.)
"	"	19	...	1.86	(Timofeiew.)
"	"	19.5	...	2.09	(de Bruyn.)
"	"	25	0.803	2.19	(Herz and Knoch.)
"	"	78 (b. pt.)	...	4.325	(Sulc.)
Propyl	C ₃ H ₇ OH	15-20	0.816	0.826	(Rohland.)
"	"	19	...	1.25	(Timofeiew.)
Amyl	C ₅ H ₁₁ OH	13	...	0.66	(Laszcynski.)
"	"	71	...	3.66	"
"	"	100	...	5.30	"
"	"	133.5	...	9.57	"
Isopropyl	(CH ₃) ₂ CH.OH	81 (b. pt.)	...	2.266	(Sulc.)
Isobutyl	(CH ₃) ₂ CHCH ₂ OH	22.5	...	0.51	(Timofeiew.)
"	"	105-107 (b. pt.)	...	2.433	(Sulc.)

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SOLUBILITY OF MERCURIC IODIDE IN MIXTURES OF ALCOHOLS AT 25°.
(Herz and Kuhn, 1908.)

In CH ₃ OH + C ₂ H ₅ OH.			In C ₃ H ₇ OH + CH ₃ OH.			In C ₃ H ₇ OH + C ₂ H ₅ OH.		
Per cent CH ₃ OH in Solvent.	d ₄ ²⁵ of Sat. Sol.	Gms. HgI ₂ per 100 cc. Sat. Sol.	Per cent C ₃ H ₇ OH in Solvent.	d ₄ ²⁵ of Sat. Sol.	Gms. HgI ₂ per 100 cc. Sat. Sol.	Per cent C ₃ H ₇ OH in Solvent.	d ₄ ²⁵ of Sat. Sol.	Gms. HgI ₂ per 100 cc. Sat. Sol.
0	0.8038	1.80	0	0.8156	3.16	0	0.8038	1.80
4.37	0.8039	1.93	11.11	...	...	8.1	0.8036	1.73
10.40	0.8046	2.08	23.80	0.8155	3.04	17.85	0.8043	1.65
41.02	0.8077	2.32	65.20	...	...	56.6	0.8057	1.55
80.69	0.8131	2.89	91.80	0.8101	1.69	88.6	...	...
84.77	0.8140	2.96	93.75	0.8110	1.67	91.2	0.8099	1.52
91.25	0.8146	2.98	96.60	0.8108	1.53	95.2	0.8108	1.44
100	0.8156	3.16	100	0.8116	1.42	100	0.8116	1.42

SOLUBILITY OF MERCURIC IODIDE IN ACETONE IN ETHYL ACETATE AND IN BENZENE.

(Sulc; Krug and McElroy — J. Anal. Ch. 6, 186, '92; Laszcynski — Ber. 27, 2285, '94.)

In Acetone.		In Ethyl Acetate.		In Benzene.	
t°.	Gms. HgI ₂ per 100 Gms. (CH ₃) ₂ CO.	t°.	Gms. HgI ₂ per 100 Gms. CH ₃ COOC ₂ H ₅ .	t°.	Gms. HgI ₂ per 100 Gms. C ₆ H ₆ .
-1	2.83	-20	1.49	15	0.22
18	3.36	+17.5	1.56	60	0.88
25	2.09 (K. and McE.)	21	1.64	65	0.95
40	4.73	40	2.53	84	1.24
58	6.07	55	3.19	80 (b.pt.)	0.825 (Sulc.)
56 (b.pt.)	3.249 (Sulc.)	76	4.31		

74-78 (b.pt.) 4.20 (Sulc.)

100 gms. acetone	dissolve 2.04 gms. HgI_2 at 23° .	(Beckmann and Stock, 1895.)
benzene	0.25 "	" "
chloroform	0.07 "	" "
acetone	2 "	(red) at 25° . (Reinders, 1900.)
"	3.09 "	(yellow) at 25° . "
ethyl acetate	1.47 "	at 18° . (Naumann, 1910.)

One liter sat. solution in benzene contains 2.24 gms. HgI_2 at 25° .

(Abegg and Sherrill, 1903.)

SOLUBILITY OF MERCURIC IODIDE IN ANILINE.

(Pearce and Fry, 1914.)

t° .	Gms. HgI_2 per 100 Gms. Aniline.	Solid Phase.	t° .	Gms. HgI_2 per 100 Gms. Aniline.	Solid Phase.
-11.48*	...	$\text{C}_6\text{H}_5\text{NH}_2 + \text{HgI}_2 \cdot 2\text{C}_6\text{H}_5\text{NH}_2$	48.8	128.1	HgI_2 (red)
-6.5	23.35	$\text{HgI}_2 \cdot 2\text{C}_6\text{H}_5\text{NH}_2$	63.6	163.8	"
+0.4	28.69	"	70.82	184.1	"
17.8	42.85	"	76.2	201.6	"
21.1	47.55	"	95.9	246.7	"
26.9	55.47	"	108†	...	" + HgI_2 (yellow)
30.1	62.05	"	115.7	281.8	HgI_2 (yellow)
36.2	75.80	"	137.2	285.2	"
42.9	96.49	"	181.1	297.9	"
46.8†	...	" + HgI_2 (red)	199.1	863.2	"

* Eutec.

† Tr. pt.

Additional data on this system are also given by Staronka, 1910.

Data for the solubility of mercuric iodide in nitrobenzene and in *p* nitrotoluene, determined by the synthetic (sealed tube method), are given by Smits and Bakhorst (1915). The transition point of HgI_2 , red to yellow, was found to be at 1.68 mol. per cent HgI_2 and 127.5° in nitrobenzene and 1.81 mol. per cent HgI_2 and 128° in *p* nitrotoluene. The interesting part of the investigation is the characteristic prolongation of the melting line above the transition point. Similar data for the solubility of mercuric iodide in nitrobenzene, *m* nitrotoluene, *p* nitrotoluene and in nitronaphthalene, determined by the freezing-point method, using a Beckmann apparatus, are given by Mascarelli (1906a). Observations on the appearance and color changes of the HgI_2 are given.

SOLUBILITY OF MERCURIC IODIDE IN CARBON DISULFIDE.

(Linebarger, 1894; Arctowski, 1894, 1895-96.)

t° .	Gms. HgI_2 per 100 Gms. Solution.	t° .	Gms. HgI_2 per 100 Gms. Solution.	t° .	Gms. HgI_2 per 100 Gms. Solution.
-116	0.017	-5	0.141	15	0.271
-93	0.023	0	0.173	20	0.320
-86.5	0.024	+5	0.207	25	0.382
-10	0.107	10	0.239	30	0.445

One liter sat. solution of mercuric iodide in CS_2 contains 3.127 gms. at 25° .

(Dawson, 1909b.)

One liter sat. solution of mercuric iodide in CCl_4 contains 0.170 gm. at 18° .

(Dawson, 1909b.)

Data are also given by Dawson for the distribution of HgI_2 between aqueous solutions of KI and CS_2 at 15° and aqueous solutions of KI and CCl_4 at 18° .

100 cc. anhydrous hydrazine dissolve 69 gms. HgI_2 with precipitation of Hg at room temp.

(Welsh and Broderson, 1915.)

SOLUBILITY OF MERCURIC IODIDE IN SEVERAL ORGANIC SOLVENTS.

(Sulc—Z. anorg. Ch. 25, 401, '00.)

Solvent.	Formula.	t°.	Gms. HgI ₂ per 100 Gms. Solvent..
Chloroform	CHCl ₃	18–20	0.040
Chloroform	CHCl ₃	61 (b. pt.)	0.163
Bromoform	CHBr ₃	18–20	0.486
Tetra Chlor Methane	CCl ₄	18–20	0.006
Tetra Chlor Methane	CCl ₄	75 (b. pt.)	0.094
Ethyl Bromide	C ₂ H ₅ Br	18–20	0.643
Ethyl Bromide	C ₂ H ₅ Br	38° (b. pt.)	0.773
Ethylene Di Bromide	C ₂ H ₄ Br ₂	18–20	0.748
Ethyl Iodide	C ₂ H ₅ I	18–20	2.041
Ethylene Di Chloride	C ₂ H ₄ Cl ₂	85.5° (b. pt.)	1.200
Iso Butyl Chloride	(CH ₃) ₂ CHCH ₂ Cl	69	0.328
Methyl Formate	HCOOCH ₃	36–38	1.166
Ethyl Formate	HCOOC ₂ H ₅	52–55	2.150
Methyl Acetate	CH ₃ COOCH ₃	56–59	2.500
Acetal	CH ₃ CH(OC ₂ H ₅) ₂	105	2.000
Epi Chlor Hydrine	CH ₂ .O.CH.CH ₂ Cl	117	6.113
Hexane	C ₆ H ₁₄	67	0.072

SOLUBILITY OF MERCURIC IODIDE IN ETHER AND IN METHYLENE IODIDE.

In Ether.		In Methylene Iodide.	
(Sulc; Laszcynski.)		(Retgers—Z. anorg. Ch. 3, 253, '03.)	
t°.	Gms. HgI ₂ per 100 Gms. (C ₂ H ₅) ₂ O.	t°.	Gms. HgI ₂ per 100 Gms. CH ₂ I ₂ .
0	0.62	15	2.5
36	0.97	100	16.6
35 (b. pt.)	0.47 (Sulc)	180	58.0

SOLUBILITY OF MERCURIC IODIDE IN FATTY BODIES.

(Mehu—J. pharm. chim. [5] 12, 249, '85.)

Solvent.	t°.	Gms. HgI ₂ per 100 Gms. Solvent.	Solvent.	t°.	Gms. HgI ₂ per 100 Gms. Solvent
Bitter Almond Oil	25	0.5	Vaseline	25	0.025
Bitter Almond Oil	100	1.3	Vaseline	100	0.20
Castor Oil	25	4.0	Poppy Oil	25	1.0
Castor Oil	100	20.0	Olive Oil	25	0.4
Nut Oil	100	1.3	Carbolic Acid	100	2.0

100 grams oil of bitter almonds dissolve 5.0 grams HgI₂. KI at 25°.
(Mehu.)

SOLUBILITY OF MERCURIC IODIDE IN OILS.

(Anon, 1903, 1904.)

Oil.		Gms. HgI ₂ per 100 cc. Oil.	Oil.		Gms. HgI ₂ per 100 cc. Oil.
Castor	Oil	1.90	Peanut	Oil	0.52
Walnut	"	1.29	Olive	"	0.45
Linseed	"	1.23	Almond	"	0.39
Cod Liver	"	0.545	Vaseline		0.26

SOLUBILITY OF MERCURIC IODIDE IN PYRIDINE.

(Determinations from -50° to 98.5° made by saturating the solvent at constant temperatures are given by Mathews and Ritter (1917). Measurements of the points of solidification of various mixtures of the two components, covering the range from 10° to 135° , are given by Staronka (1910).

t°.	Gms. HgI ₂ per 100 Gms. Sat. Sol.	Solid Phase.	t°.	Gms. HgI ₂ per 100 Gms. Sat. Sol.	Solid Phase.
-50	1.93	HgI ₂ ·2C ₅ H ₅ N	90.08	61.43	HgI ₂ ·2C ₅ H ₅ N
-31.5	4.27	"	100	65.72	"
-10	10.28	"	105	68.89	"
-0.1	14.85	"	107 m. pt.	72.09	"
+ 8.83	18.42	"	105	75.67	"
20.02	24.40	"	100	79.73	"
25.55	27.90	"	90	84.16	"
40.08	37.64	"	87 Eutec.	85.17	" + HgI ₂ ·C ₅ H ₅ N
50.02	43.15	"	100	86	HgI ₂ ·C ₅ H ₅ N
60.07	48.29	"	120	87.16	"
80.05	57.60	"	135	88.78	"

SOLUBILITY OF MERCURIC IODIDE IN QUINOLINE.

(Staronka, 1910.)

I

t°.	Mols. HgI ₂ per 100 Mols. HgI ₂ + C ₉ H ₇ N.	Solid Phase.	t°.	Mols. HgI ₂ per 100 Mols. HgI ₂ + C ₉ H ₇ N.	Solid Phase.
100	4.7	HgI ₂ ·2C ₉ H ₇ N	160	37.7	HgI ₂ ·C ₉ H ₇ N
115.5	9.1	"	165	41.6	"
133.5	13.2	"	165	43	"
138	23.1	"	170	48.8	"
145	26.7	HgI ₂ ·C ₉ H ₇ N	169.5	49.5	"
153	31.4	"	166.5	54.4	"

100 gms. liquid Sulfur Dioxide dissolve 0.012 gm. HgI₂ at 0° . (Jander and Ruppolt, 1937.)

Fusion-point data are given for the following mixtures.

HgI ₂ + AgNO ₃	(Bergmann, 1921, 1922-4, 1926.)
" + HgSO ₄	(Paic, 1930, 1933.)
" + I	(Olivari, 1908.)
" + TiNO ₃	(Bergmann, 1926.)
" + TiSO ₄	(Woskresenskaja, 1929.)

MERCURIC Ammonium IODIDE HgI₂·2NH₄I·H₂O

100 gms. sat. sol. of Mercuric Ammonium Iodide in Water contain 22.6 gms. Hg, 4.5 gms. NH₄ and 62.3 gms. I at 26° ; d of sat. sol. = 2.98. (Duboin, 1905.)

MERCURIC IODIDE Diamine (NH₃)₂HgI₂.

Data for the solubility of diamine mercuric iodide in aqueous ammonia solutions at 20° are given by Francois (1900). The solid is not stable in solutions containing less than 48 gms. NH₃ per liter.

MERCUROUS IODATE Hg₂(IO₃)₂.

The Solubility Product of Mercurous Iodate in Water at 25° is 1.3×10^{-18} as quoted from Spencer, 1912, by Brodsky, 1929.

MERCURY NITRATE (ic) $\text{Hg}(\text{NO}_3)_2$, (ous) $\text{Hg}_2(\text{NO}_3)_2$.

100 gms. anhydrous lanolin (m. pt. about 46°) dissolve 1.15 gm. $\text{Hg}(\text{NO}_3)_2$ at 45° . (Klose, 1907.)

100 cc. anhydrous hydrazine dissolve about 2 gms. $\text{Hg}_2(\text{NO}_3)_2$ with precipitation of Hg at room temp. (Welsh and Broderson, 1915.)

MERCUROUS NITRATES

**EQUILIBRIUM IN THE SYSTEM, MERCUROUS OXIDE, NITROGEN
PENTOXIDE AND WATER AT 25° .**

(Denham and Fife, 1933.)

In the case of the normal salt, mixtures of the required amounts of HNO_3 , H_2O and finely ground mercurous nitrate were shaken in sealed bottles until equilibrium was reached. For the preparation of the basic salts either mercurous nitrate was shaken with the necessary amount of water or mercurous oxide was shaken with HNO_3 . The mercury in the saturated solutions was determined by electrolysis and the nitrate by a modification of the Devarda method.

d. of sat. solution	Gms. per 100 Hg_2O	gms. sat. sol. N_2O_5	Solid Phase	d of sat. solution	Gms. per 100 Hg_2O	gms. sat. sol. N_2O_5	Solid Phase
1.039	3.03	1.00	A	1.557	31.00	12.10	α D
1.058	4.64	1.40	"	1.447	26.88	12.27	"
1.082	6.55	2.30	"	1.396	22.30	12.87	"
1.095	7.57	2.44	"	1.382	21.21	13.30	"
1.113	8.66	3.01	"	1.359	19.25	14.00	" + β D NO
1.117	9.12	3.22	" + B	1.366	19.63	14.53*	α D
1.139	10.46	3.61	B	1.455	22.97	15.84*	"
1.200	15.10	5.44	"	1.464	23.30	16.20*	"
1.275	18.42	6.60	"	1.563	27.65	17.20*	"
1.328	21.10	7.70	"	1.638	30.80	18.00*	"
1.366	23.53	8.22	"	1.781	34.88	19.35*	"
1.450	27.28	9.61	"	1.485	26.38	13.29*	β D
1.502	29.31	10.43	" + C	1.442	24.22	13.55*	"
1.510	29.70	10.50	C	1.405	22.12	13.82*	"
1.527	30.18	10.75	"	1.365	19.84	13.87*	"
1.565	31.76	11.20	"	1.359	19.25	14.00	"
1.608	33.00	11.79	" + D	1.426	20.66	17.70	"

* = Metastable

A = $2\text{Hg}_2\text{O} \cdot \text{N}_2\text{O}_5 \cdot \text{H}_2\text{O}$; B = $5\text{Hg}_2\text{O} \cdot 3\text{N}_2\text{O}_5 \cdot 3\text{H}_2\text{O}$; C = $4\text{Hg}_2\text{O} \cdot 3\text{N}_2\text{O}_5 \cdot \text{H}_2\text{O}$;

D = $\text{Hg}_2(\text{NO}_3)_2 \cdot 2\text{H}_2\text{O}$ which exists in an α and a β form.

MERCURIC Ethyl and Other NITRATES

SOLUBILITY OF EACH SEPARATELY IN WATER AT 25° .

(Johns, Peterson and Hixon, 1930.)

Compound	Formula	Gm. Moles. Compound per liter sat. sol.
Ethyl Mercuric Nitrate	$\text{C}_2\text{H}_5\text{HgNO}_3$	0.0239
Butyl " "	$\text{C}_4\text{H}_9\text{HgNO}_3$	0.003
Benzyl " "	$\text{C}_6\text{H}_5\text{CH}_2\text{HgNO}_3$	0.00263
β Xyllyl " "	$\text{C}_6\text{H}_4(\text{CH}_3)_2\text{HgNO}_3$	0.00057
Phenyl " "	$\text{C}_6\text{H}_5\text{HgNO}_3$	0.00236

MERCUROUS OXIDE Hg_2O

The Solubility Product of Mercurous Oxide in Water at 25° is 1.8×10^{-24} as quoted from Burgarsky, 1897, by Brodsky, 1929.

MERCURIC OXIDE HgO

SOLUBILITY IN WATER.

(Schick, 1903.)

t°	Gms. per 1000 cc. Solution.	
25	0.0518 yellow HgO	0.0513 red HgO
100	0.410 yellow HgO	0.379 red HgO

At 25° the mixtures were constantly agitated for 4 days or longer. At 100° the solutions were boiled and stirred for 5 hours. A longer period would probably have caused better agreement between the red and yellow HgO .

One liter H_2O dissolves 0.05 gm. HgO (red, large grains) at 25° . (Hulett, 1901.)

One liter H_2O dissolves 0.15 gm. HgO (red, finest grains) at 25° . "

Very careful determinations of the solubility of yellow and of red Mercuric Oxide in Water - both determined directly and by extrapolation from measurements in aqueous alkali solutions-gave the value 0.000225 gm. mols. (= 0.0487 gm.) of red HgO per 1000 gms. H_2O and 0.000237 gm. mols. (= 0.0513 gms.) of yellow HgO per 1000 gms. H_2O , at 25° . (Garrett and Hirschler, 1938.)

One liter sat. sol. of $\text{Hg}(\text{OH})_2$ in H_2O contain 0.000251 gm. mol. (= 0.0544 gm.) HgO at 25° . (Herz and Hiebenthal, 1928.)

SOLUBILITY OF YELLOW AND OF RED MERCURIC OXIDE IN AQUEOUS SOLUTIONS OF NITRIC ACID AT 25° .

(Garrett and Howell, 1939.)

Results for Yellow Mercuric Oxide

Results for Red HgO

Gm. Mols. per 1000 gms. H_2O		Gm. Mols. per 1000 gms. H_2O		Gm. Mols. per 1000 gms. H_2O		Gm. Mols. per 1000 gms. H_2O	
$\text{HNO}_3 \times 10^{-4}$	$\text{HgO} \times 10^{-4}$	$\text{HNO}_3 \times 10^{-4}$	$\text{HgO} \times 10^{-4}$	$\text{HNO}_3 \times 10^{-4}$	$\text{HgO} \times 10^{-4}$	$\text{HNO}_3 \times 10^{-4}$	$\text{HgO} \times 10^{-4}$
0.5	2.43	156	58.5	700	312	1.0	2.98
1.0	2.57	200	65.5	703	312	2.0	3.14
2.0	2.67	200	68.0	722	329	3.0	2.77
4.0	3.11	300	111.0	743	333	5.0	3.48
6.0	3.35	300	108.0	761	349	7.0	3.56
8.0	3.80	400	173.0	780	362	9.0	4.02
10.3	4.15	400	169.0	976	449	20.0	6.32
20.0	6.08	500	217.0	1170	536	30.0	9.17
40.0	12.1	585	236.0	1370	638	50.0	14.2
60.0	18.3	600	253.0	1400	596	70.0	20.2
80.0	23.2	634	262.0	1560	718	90.0	27.9
106.0	30.0	683.	299.0	1600	662	200.0	64.2

The above values for HNO_3 are those of the solutions as made up. The solutions were maintained in an atmosphere of nitrogen. Calculations of the acidity corrected for the amount of acid used to react with the oxide are given.

SOLUBILITY OF MERCURIC OXIDE IN AQUEOUS HYDROFLUORIC ACID AT 25°.

(Jaeger, 1901.)

Normality of HF.	Gms. Hg per 9.6 cc. Sat. Sol.	Gm. Atoms Hg per Liter.
0.12	0.0242	0.01258
0.24	0.0475	0.0247
0.57	0.1210	0.0629
1.11	0.2247	0.1168
2.17	0.4976	0.2586

SOLUBILITY OF MERCURIC OXIDE IN AQUEOUS SALT SOLUTIONS AT 25°.

(Herz and Liebenthal, 1928.)

Results for aqueous:

Potassium Chloride

Lithium Chloride

Sodium Chloride

Gm. Equivalents per liter		Gm. Equivalents per liter		Gm. Equivalents per liter	
KCl	HgO	LiCl	HgO	NaCl	HgO
0.35	0.0008	0.35	0.0008	1.05	0.0026
0.70	0.0011	0.51	0.0011	1.55	0.0036
0.85	0.0013	0.74	0.0014	2.12	0.0046
1.49	0.0023	0.99	0.0020	3.13	0.0074
2.35	0.0038	2.15	0.0053	4.22	0.0091
3.13	0.0054	2.47	0.0061	5.45	0.0158

MERCURY OXIDE (ic) HgO.

SOLUBILITY OF MERCURIC OXIDE IN AQUEOUS SOLUTIONS OF SODIUM HYDROXIDE AT 25°.

(Fuseya, 1920.)

The mixtures were rotated in sealed tubes for at least 4 days. Equilibrium was approached both from above and below.

Mols. NaOH per liter of sat. sol.	Millimols. HgO per liter of sat. sol.	Mols. NaOH per liter of sat. sol.	Millimols. HgO per liter of sat. sol.
0.0000	23.4	0.502	26.6
0.0096	24.6	1.0758	28.3
0.0503	24.7	2.09	30.9
0.0955	24.9		

It is pointed out by Garrett and Hirschler, 1938, that through an obvious error the above solubilities of HgO are 100 times too high.

SOLUBILITY OF YELLOW AND OF RED MERCURIC OXIDE IN AQUEOUS SOLUTIONS OF SODIUM HYDROXIDE AT 25°.

(Garrett and Hirschler, 1938.)

The determinations were made in an atmosphere of nitrogen. Equilibrium was approached both from under saturation and super saturation. The alkali was determined by titration, using methyl orange as indicator. The mercury was determined by a potentiometric method.

Results for Yellow HgO

Results for Red HgO

Gm. Mols. per 1000 gms. H ₂ O		Gm. Mols. per 1000 gms. H ₂ O		Gm. Mols. per 1000 gms. H ₂ O		Gm. Mols. per 1000 gms. H ₂ O	
NaOH	HgO	NaOH	HgO	NaOH	HgO	NaOH	HgO
0.00010	0.000234	0.3467	0.000249	0.00088	0.000225	0.7223	0.000251
0.00082	0.000238	0.5995	0.000255	0.0050	0.000225	1.001	0.000262
0.0018	0.000232	0.8515	0.000265	0.0093	0.000226	1.638	0.000272
0.0040	0.000237	1.512	0.000282	0.0187	0.000224	1.987	0.000276
0.0100	0.000237	2.562	0.000296	0.1064	0.000227	2.940	0.000294
0.0207	0.000237	3.405	0.000306	0.3398	0.000231	3.956	0.000297
0.1015	0.000244	4.460	0.000312	0.4406	0.000242	4.936	0.000298
0.2230	0.000241	5.952	0.000311	0.5818	0.000246		

SOLUBILITY OF YELLOW MERCURIC OXIDE IN AQUEOUS ALKALIES AND
ALKALINE SALT SOLUTIONS AT 25°.

(Garrett and Hirschler, 1938.)

Gm. Mols. per 1000 gms. H ₂ O			Gm. Mols. per 1000 gms. H ₂ O		
Alkali	+	Salt HgO	Alkali	+	Salt HgO
0.1082 KOH	—	0.000240	0.1328 NaOH	2.400 KNO ₃	0.000384
0.3038 "	—	0.000243	0.1462 "	1.072 NaNO ₃	0.000326
0.8175 "	—	0.000253	0.1738 "	2.637 "	0.000496
0.0689 LiOH	—	0.000239	0.1682 "	6.397 "	0.000753
0.2019 "	—	0.000246	0.1433 "	0.5863 Na ₂ SO ₄	0.000301
0.4667 "	—	0.000252	0.1380 "	1.145 "	0.000347
0.1361 NaOH	0.8143 KNO ₃	0.000291	0.1649 "	1.668 "	0.000370
0.1789 "	1.725 "	0.000337	0.1454 "	2.137 "	0.000390

MERCURY SULFIDE HgS.

One liter H₂O dissolves 0.054×10^{-6} mols. HgS = 0.0000125 gm. at 18°.

(Weigel, 1906, 1907. See also Bruner and Zawadzki.)

MERCUROUS SULFATE Hg₂SO₄

The Solubility Product of Mercurous Sulfate in Water at 25° is 4.7×10^{-17} as quoted from Bugarsky, 1897; by Brodsky, 1929.

SO

SOLUBILITY IN WATER, IN SULFURIC ACID AND IN POTASSIUM SULFATE AT 25°.
(Drucker, 1901; Wright and Thomson, 1884-85; Wilsmore, 1900.)

Solvent.	Hg ₂ SO ₄ per Liter.	
	Gm. Mol.	Gms.
Water	11.71×10^{-4}	0.58 (0.47 W. and T., 0.39 W.)
Aq. H ₂ SO ₄ (1.96 gms. per liter)	8.31	0.41
Aq. H ₂ SO ₄ (4.90 gms. per liter)	8.78	0.44
Aq. H ₂ SO ₄ (9.80 gms. per liter)	8.04	0.40
Aq. K ₂ SO ₄ (34.87 gms. per liter)	9.05	0.45

SOLUBILITY OF MERCUROUS SULFATE IN WATER AT DIFFERENT TEMPERATURES.
(Barre, 1911.)

t°.	Gms. per 100 Gms. Sat. Sol.		Solid Phase.
	Hg ₂ SO ₄ .	H ₂ SO ₄ .	
16.5	0.055	0.008	Hg ₂ SO ₄
33	0.060	0.018	"
50	0.065	0.037	"
75	0.074	0.063	"
100	0.092	0.071	"

The mixtures were kept at constant temp. but not constantly agitated. By successive treatment of a given amount of Hg₂SO₄ with H₂O, it is gradually converted to an almost insoluble basic salt, Hg₂O.Hg₂SO₄.H₂O.

SOLUBILITY OF MERCUROUS SULFATE IN AQUEOUS POTASSIUM SULFATE SOLUTIONS. (Barre, 1911.)

Results at 15°.			Results at 33°.			Results at 75°.		
Gms. per 100	Gms. Sat. Sol.		Gms. per 100	Gms. Sat. Sol.		Gms. per 100	Gms. Sat. Sol.	
K ₂ SO ₄ .	Hg ₂ SO ₄ .	H ₂ SO ₄ (free).	K ₂ SO ₄ .	Hg ₂ SO ₄ .	H ₂ SO ₄ (free).	K ₂ SO ₄ .	Hg ₂ SO ₄ .	H ₂ SO ₄ (free)
2.90	0.0475	0.0080	2.94	0.0677	0.0250	3.10	0.1344	0.1684
5.70	0.0703	0.0093	5.68	0.1015	0.0350	5.75	0.2120	0.2135
8.22	0.0912	0.0098	8.30	0.1364	0.0441	8.50	0.2951	0.2514
8.77	0.0994	...	10.70	0.1724	0.0438	13.20	0.4610	0.2503
9.44	0.1080	0.0110	11.90	0.1902	0.0420	17.30	0.6440	0.2225

SOLUBILITY OF MERCUROS SULFATE IN AQUEOUS SOLUTIONS OF SULFURIC ACID
AT 0° AND AT 28°.

(Craig, Vinal and Vinal, 1936.)

Equilibrium was approached both from above and below. Mercury was determined electrolytically and the H_2SO_4 in the electrolyzed solution was titrated. The acid equivalent to the Hg was subtracted from the total to obtain the H_2SO_4 in the original solution. The results were plotted and the following average values obtained from the curve.

Gm. Mols. H_2SO_4 per 1000cc solution			Gm. Hg per 100cc sat. sol. at:			Gm. Mols. H_2SO_4 per 1000cc solution			Gm. Hg per 100cc sat. sol. at:		
			0°	28°					0°	28°	
0.001	0.0351	—				0.100	0.0183	0.0344			
0.002	0.0290	0.0463				0.200	0.0198	0.0379			
0.004	0.0239	0.0395				0.40	0.0224	0.0423			
0.006	0.0215	0.0360				0.60	0.0239	0.0451			
0.008	0.0203	0.0346				0.80	0.0247	0.0467			
0.010	0.0197	0.0338				1.00	0.0249	0.0470			
0.020	0.0182	0.0318				1.50	0.0240	0.0452			
0.040	0.0178	0.0317				2.00	0.0216	0.0409			
0.060	0.0178	0.0327				3.00	0.0139	0.0294			
0.080	0.0180	0.0337				4.00	0.0078	—			

The above results calculated from 28° to 25° agree very closely with the previous careful determinations of Hulett, 1904.

SO

MERCURY SULFATE (ic) $HgSO_4$.

EQUILIBRIUM IN THE SYSTEM, MERCURY OXIDE, SULFUR TRIOXIDE, WATER
(Hoitsema, 1895.)

Results expressed in molecules per sum of 100 molecules of the three components of the system. The mixtures were rotated for 3 hours or longer.

Results at 25°.

Results at 50°.

Liquid Phase.			Solid Phase.	Liquid Phase.			Solid Phase.
H ₂ O.	SO ₃ .	HgO.		H ₂ O.	SO ₃ .	HgO.	
98.5	1.24	0.33	3HgO.SO ₃	98.9	0.96	0.17	3HgO.SO ₃
96.6	2.49	0.92	"	96	3.05	0.93	"
94.4	3.93	1.65	"	93.2	4.92	1.90	"
93.9	4.24	1.85	3HgO.SO ₃ and 3HgO.2SO ₃ .2H ₂ O	92.8	5.10	2.09	"
94.4	4.52	2.12		92.8	5.16	2.06	"
93.4	4.65	1.94	3HgO.2SO ₃ .2H ₂ O	92.5	5.34	2.12	"
92.9*	4.81	2.29	3HgO.SO ₃	92.2	5.57	2.20	3HgO.SO ₃ and 3HgO.2SO ₃ .2H ₂ O
92.9	5.11	1.98	3HgO.2SO ₃ .2H ₂ O	92.1	5.75	2.11	
92.3*	5.20	2.54	3HgO.SO ₃	92	5.80	2.16	"
92.3	5.58	2.09	3HgO.2SO ₃ .2H ₂ O	91.2*	6.27	2.56	3HgO.SO ₃ and HgO.SO ₃
92.1	5.81	2.08	"	91.5	6.34	2.19	
91.9	5.97	2.90	3HgO.SO ₃	91.3*	6.37	2.30	3HgO.2SO ₃ .2H ₂ O and HgO.SO ₃
91.9	6.15	2.05	3HgO.2SO ₃ .2H ₂ O	91.6	6.69	1.75	
91.3	6.54	2.13	"	91.1	8.32	0.57	"
91.2	6.77	2.02	HgO.SO ₃ .H ₂ O	90.5	9.11	0.4	"
91.3	6.90	1.80	"	89.6	10.2	0.23	"
91.3	7.67	1.01	"	86.7	13.2	0.06	"
91.3	7.84	0.89	HgO.SO ₃ .H ₂ O and HgO.SO ₃	31.6	68.4	0.03	"
91	8.36	0.69	"				
90.5	8.95	0.53	"				
89.2	10.6	0.22	HgO.SO ₃				
75.8	24.2	trace	"				
39.2	60.7	trace	"				

* Indicates unstable equilibrium

SOLUBILITY OF BASIC MERCURIC SULFATE IN AQUEOUS SOLUTIONS
OF SULFURIC ACID AT 25-30°.

(Vosburgh and Lackey, 1930.)

The mercury was determined by titration with standard thiocyanate solution.

Gm. Mols. H_2SO_4 per liter	Gm. Mols. per liter	
	HgO	SO_3
0.01194	0.00103	0.01228
0.0954	0.0131	0.0998
0.1450	0.0203	0.1518

100 gms. liquid Sulfur Dioxide dissolve 0.010 gm. $HgSO_2$ at 0°. (Jander and Ruppolt, 1937.)

Freezing-point data for mixtures of $Hg_2SO_4 + H_2SO_4$ are given by Kendall and Davidson, 1921.

SeO MERCURY SELENITE $HgSeO_3$.

SOLUBILITY IN AQUEOUS SODIUM SELENITE SOLUTIONS AT 25°.
(Rosenheim and Pritze, 1909.)

Normality of Na_2SeO_3 Solution.	Gms. $HgSeO_3$ per 100 Gms. Sat. Sol.	Normality Na_2SeO_3 of Solution.	Gms. $HgSeO_3$ per 100 Gms. Sat. Sol.
0.0625	0.18	0.5	0.70
0.125	0.32	1	1.39
0.25	0.53	2	2.73

HOLMIUM SULFATE $Ho_2(SO_4)_3 \cdot 8H_2O$

100 gms. H_2O dissolve 8.181 gms. $Ho_2(SO_4)_3 \cdot 8H_2O$ at 20° and 4.52 gms. at 40°. (Jackson and Reinacker, 1930.)

IODINE I_2

SOLUBILITY OF IODINE IN GASES AND THE VAPORS OF SOLVENTS.

Experimental determinations of the solubility of Iodine vapor in air are given by Baxter, 1907 and Baxter and Grose, 1915; in CO_2 and in H_2 by Braune and Strassmann, 1929; in air N_2 , O_2 , CH_4 , CO and the vapors of $CHCl_3$, CS_2 , CCl_4 , Hexane and Ethyl Ether, by Brüll and Ellerbrock, 1934.

SOLUBILITY OF IODINE IN WATER.

The results of Sammet, 1905; Carter, 1925, 1928; Hartley, 1908; Lanza, 1931, and Kracek, 1931, were plotted on cross section paper and the following values read from the average curve.

t°	Gms. I per liter sat. sol.	t°	Gms. I per liter sat. sol.	t°	Gms. I per liter sat. sol.
0	0.14	30	0.385	80	2.25
10	0.20	40	0.52	90	3.15
20	0.285	50	0.71	100	4.45
25	0.335	60	1.00	106	5.60
		70	1.50	112	7.20

Lanza found that supersaturation occurs easily, especially at the higher temperatures, and such solutions give up their iodine very slowly.

By means of determinations made in sealed tubes by the synthetic method, Kracek found that above 112.3° two liquid layers are formed. The critical solution temperature, estimated to be above 300°, could not be reached because of the extremely high vapor pressure developed by the system. The following points on the curve for the liquid layers were determined.

Aqueous Layer		Liquid Iodine Layer	
t°	Gms. I. per 100 gms. liquid layer	t°	Gms. I. per 100 gms. liquid layer
126.5	0.976	112.3	99.907*
143.2	1.422	155	99.712
156.4	1.947	186	99.530
175.9	3.082	>225	99.083
188.4	4.125		
206.7	6.587		

SOLUBILITY OF IODINE IN AQUEOUS SOLUTIONS OF HYDROBROMIC ACID.

(Lee and Lee, 1936.)

Gm. Mols. HBr per liter sat. sol.	Gm. Mols. I ₂ per liter sat. solution at:			
	15°	25°	35°	45°
0.05	0.00167	0.00221	0.00281	0.00302
0.100	0.00241	0.00319	0.00400	0.00533
0.588	0.00849	0.01048	0.01348	0.01766
1.209	0.01678	0.02109	0.02690	0.03511
1.851	0.02720	0.03284	0.04165	0.04878
3.182	0.04241	0.05192	0.06478	0.08354

I

SOLUBILITY OF IODINE IN AQUEOUS SOLUTIONS OF BARIUM IODIDE AT 23°.

(Pearce and Eversole, 1924.)

Gm. mols. per 1000 gms. H ₂ O		Gm. mols. per 1000 gms. H ₂ O	
BaI ₂	I ₂	BaI ₂	I ₂
0.0000	0.001329	0.16497	0.16872
0.000686	0.002044	0.34880	0.39500
0.003120	0.004482	0.39633	0.45460
0.006287	0.007574	0.57189	0.81690
0.031674	0.032199	0.87640	1.4674
0.047716	0.048413	1.1922	2.2880
0.080477	0.079370		

SOLUBILITY OF IODINE IN AQUEOUS SOLUTIONS OF HYDROBROMIC ACID, HYDROCHLORIC ACID AND OF HYDRIODIC ACID.

(Oliveri-Mandala and Angenica, 1920.)

In aq. HBr at 25°.		In aq. HCl at 25°.4.		In aq. HI at 25°.2.	
Gm. mols. per liter		Gm. mols. per liter		Gm. mols. per liter	
HBr.	I ₂ .	HCl.	I ₂ .	HI.	I ₂ .
0.500	0.0081	0.500	0.00170	0.0604	0.0295
0.635	0.0096	1.1230	0.00256	0.0922	0.0459
1.2433	0.0203	1.5540	0.00320	0.1209	0.0610
1.8649	0.0328	1.8010	0.00373	0.2110	0.1117
2.7973	0.0514	2.0539	0.00430	0.3120	0.1633
3.7297	0.0750	2.5530	0.00511	0.4230	0.2358
		2.3139	0.00640	0.5000	0.3000
		3.8550	0.00730	0.6350	0.3950

Results for the solubility of iodine in aq. HCl solutions at 25°, which do not agree with the above, are given by Rây and Sarkar, 1922.

SOLUBILITY OF IODINE IN AQUEOUS SOLUTIONS OF NITRIC ACID.

(Carter, 1925.)

Results at 10°.		Results at 23°.		Results at 35°.	
Wt. per cent HNO ₃ .	Gm. mols. I ₂ per liter.	Wt. per cent HNO ₃ .	Gm. mols. I ₂ per liter.	Wt. per cent HNO ₃ .	Gm. mols. I ₂ per liter.
11.80	0.000969	10.91	0.00160	3.31	0.00187
23.88	0.001035	23.16	0.00179	6.50	0.00204
32.35	0.001020	33.62	0.00186	15.50	0.00233
40.82	0.000985	42.28	0.00185	28.72	0.00260
49.57	0.000957	52.77	0.00189	42.63	0.00275
55.82	0.000962	63.81	0.00236	43.13	0.00273
64.30	0.00108	69.65	0.00312	58.37	0.00368
70.00	0.00178	72.60	0.00394		

SOLUBILITY OF IODINE IN AQUEOUS SOLUTIONS OF ACIDS.

Aqueous Acid.	Mols. I. per Liter Sat. Sol.	Gms. I per Liter Sat. Sol.	Authority.
0.001 <i>n</i> HCl	0.001332	0.338	(Bray and MacKay, 1910.)
0.10 <i>n</i> HNO ₃	0.001340	0.340	(Sammet, 1905.)
0.10 <i>n</i> H ₂ SO ₄	0.001342	0.341	"

SOLUBILITY OF IODINE IN AQUEOUS SOLUTIONS OF SULFURIC ACID AT 25°.

(Carter, 1925.)

I	Wt. per cent H ₂ SO ₄ .	Gm. mols. I ₂ per liter.	Color of solution.	Wt. per cent H ₂ SO ₄ .	Gm. mols. I ₂ per liter.	Color of solution.
	11.87	0.00102	Brown	59.53	0.000380	Pinkish + brown
	22.72	0.00082	"	72.04	0.000270	Pink
	33.25	0.000615	"	87.37	0.000200	"
	40.42	0.000545	" + Pinkish			

SOLUBILITY OF IODINE IN AQUEOUS SOLUTIONS OF HYDRIODIC ACID AT 25°.

(Carter and Hoskins, 1929.)

Gm. Mols. per 1000 gm. H ₂ O		Gm. Mols. per 1000 gm. H ₂ O	
HI	I ₂	HI	I ₂
0.2117	0.1326	1.321	0.7908
0.5284	0.2956	1.763	0.9228
0.8810	0.4715	4.964	2.784

SOLUBILITY OF IODINE IN AQUEOUS MERCURIC CHLORIDE AND IN AQUEOUS CADMIUM IODIDE SOLUTIONS AT 25°.

In Aq. HgCl ₂ . (Herz and Paul, 1914.)				In Aq. CdI ₂ . (Van Name and Brown, 1917.)			
Millimols per Liter.		Gms. per Liter.	Gms. per Liter.		Gms. per Liter.		
Hg.	I ₂ .		HgCl ₂ .	I.	CdI ₂ .	I.	
0	1.34	0	0.340	3.66	2.072		
94.44	12.94	25.64	3.285	45.78	9.056		
124.42	14.60	33.78	3.706	91.56	11.386		
195.42	18.06	54.29	4.583	183.12	14.040		
334.60	25.43	90.84	6.454				

SOLUBILITY OF IODINE IN AQUEOUS SOLUTIONS OF CHLORIDES AT 25°.

(Carter and Hoskins, 1929.)

In Aqueous Solutions of:

Hydrochloric Acid Potassium Chloride Magnesium Chloride Barium Chloride

Gm. Mols. per 1000 Gm. Mols. H ₂ O		Gm. Mols. per 1000 Gm. Mols. H ₂ O		Gm. Mols. per 1000 Gm. Mols. H ₂ O		Gm. Mols. per 1000 Gm. Mols. H ₂ O	
$\frac{\text{HCl}}{\text{I}_2}$		$\frac{\text{KCl}}{\text{I}_2}$		$\frac{1/2 \text{ MgCl}_2}{\text{I}_2}$		$\frac{1/2 \text{ BaCl}_2}{\text{I}_2}$	
8.48	0.0431	6.15	0.0349	8.48	0.0394	3.67	0.0305
17.9	0.0655	12.3	0.0438	13.0	0.0465	4.89	0.0318
25.1	0.0793	24.6	0.0589	26.3	0.0634	12.1	0.0426
31.5	0.0951	36.3	0.0711	53.5	0.0741	24.0	0.0538
65.3	0.170	48.2	0.0822	67.5	0.0750	35.6	0.0610
79.5	0.197	60.6	0.0905	96.1	0.0732	46.9	0.0660
109.2	0.252	73.9	0.0975	125.9	0.0636	57.8	0.0676
141.0	0.299	86.8	0.1003	141.3	0.0573	68.6	0.0671

The authors also give results for the solubility of iodine at 25° in aqueous solutions of NaBr + Na₂SO₄, NaI + NaNO₃ and NaI + Na₂SO₄.

SOLUBILITY OF IODINE IN AQUEOUS SOLUTIONS OF CHLORIDES AT 25°.

(Herz and Hiebenthal, 1929.)

In aqueous solutions of:

Lithium Chloride

Sodium Chloride

Potassium Chloride

Gm. Mols. per liter sat. solution		Gm. Mols. per liter sat. solution		Gm. Mols. per liter sat. solution	
$\frac{\text{LiCl}}{\text{I}_2}$		$\frac{\text{NaCl}}{\text{I}_2}$		$\frac{\text{KCl}}{\text{I}_2}$	
0.46	0.00379	0.20	0.00274	0.20	0.00276
0.96	0.00503	0.44	0.00344	0.34	0.00292
1.98	0.00679	1.23	0.00511	0.64	0.00389
3.90	0.00746	2.39	0.00612	1.93	0.00670
6.43	0.00596	3.45	0.00613	2.75	0.00800
12.08	0.00127	5.34	0.00534	4.85	0.00756

Magnesium Chloride

Strontium Chloride

Barium Chloride

Gm. Mols. per liter sat. solution		Gm. Mols. per liter sat. solution		Gm. Mols. per liter sat. solution	
$\frac{1/2 \text{ MgCl}_2}{\text{I}_2}$		$\frac{1/2 \text{ SrCl}_2}{\text{I}_2}$		$\frac{1/2 \text{ BaCl}_2}{\text{I}_2}$	
0.39	0.00339	0.46	0.00371	0.23	0.00278
0.59	0.00419	0.86	0.00468	0.52	0.00388
1.49	0.00620	1.46	0.00571	0.83	0.00453
3.00	0.00764	2.37	0.00665	1.59	0.00571
4.55	0.00718	4.50	0.00637	2.70	0.00675
9.72	0.00148	6.16	0.00489	3.35	0.00675

IODINE I_2

SOLUBILITY OF IODINE IN SOLUTIONS OF VARIOUS SALTS IN WATER AND IN SOLUTIONS OF THE SAME SALTS IN 0.025 NORMAL POTASSIUM IODIDE AT 25°.
(v. Kisa and Urmanczy, 1931.)

Gm. Mols. Salt per liter		Gm. Mols. I_2 per liter in:		Gm. Mols. Salt per liter		Gm. Mols. I_2 per liter in:	
		H_2O Solution	0.025N KI Solution			H_2O Solution	0.025N KI Solution
0.0		0.001332	0.01362	0.5	$NaNO_3$	0.001238	0.01280
0.5	KCl	0.002306	0.01342	1.5	"	0.001048	0.01146
1.0	"	0.002821	0.01308	3.0	"	0.000780	0.00798
1.5	"	0.003315	0.01271	5.0	"	0.000573	0.00567
2.0	"	0.003753	0.01250	7.5	"	0.000369	0.00370
3.0	"	0.004476	0.01231	0.5	$LiNO_3$	0.001270	0.01292
4.0	"	0.004890	0.01219	1.5	"	0.001187	0.01202
0.5	NaCl	0.002083	0.01306	3.5	"	0.001038	0.01045
1.5	"	0.002960	0.01196	5.5	"	0.000856	0.00836
3.0	"	0.003320	0.00987	8.7	"	0.000564	0.00586
5.0	"	0.002942	0.00707	0.5	K_2SO_4	0.001190	0.01246
0.5	LiCl	0.002330	0.01351	1.0	"	0.001034	0.01126
1.5	"	0.003246	0.01270	1.37	"	0.000909	0.01052
3.5	"	0.003876	0.00971	0.25	Na_2SO_4	0.001210	0.01283
6.0	"	0.003275	0.00655	0.75	"	0.001052	0.01139
9.0	"	0.002012	0.00349	2.0	"	0.000705	0.00837
13.0	"	0.000301	0.00136	3.5	"	0.000440	0.00526
0.6714	$CaCl_2$	0.002505	0.01338	0.5	Li_2SO_4	0.001127	0.01224
1.676	"	0.003675	0.01265	1.5	"	0.000798	0.01015
3.35	"	0.004382	0.01080	3.0	"	0.000474	0.00692
5.025	"	0.003811	0.00869	5.0	"	0.000238	0.00386
6.714	"	0.003136	0.00671	0.6855	$Mg(NO_3)_2$	0.001230	0.1303
0.6882	$MgCl_2$	0.002492	0.01314	1.714	"	0.001053	0.01193
1.72	"	0.003595	0.01240	3.427	"	0.000891	0.01045
3.441	"	0.003959	0.01023	5.135	"	0.000674	0.00874
5.162	"	0.003752	0.00774	6.855	"	0.000550	0.00717
6.882	"	0.002999	0.00565	0.5	$MgSO_4$	0.001174	0.01239
0.5	$BaCl_2$	0.002226	0.01286	3.0	"	0.000600	0.00742
1.5	"	0.003035	0.00941	5.0	"	0.000351	0.00396
3.0	"	0.003550	0.00665	0.5264	$Ca(NO_3)_2$	0.001229	0.01314
0.5	KNO_3	0.001257	0.01305	1.316	"	0.001097	0.01234
1.0	"	0.001161	0.01277	2.632	"	0.000910	0.01104
2.0	"	0.001041	0.01215	3.948	"	0.000736	0.00967
3.0	"	0.000902	0.01178	5.264	"	0.000615	0.00854
				0.25	$Ba(NO_3)_2$	0.001300	0.01286
				0.50	"	0.001243	1.01249

SOLUBILITY OF IODINE IN AQUEOUS SOLUTIONS OF MIXTURES OF SALTS AT 25°.
(Laher and Lewinsohn, 1934.)

Gm. Mols. Salts per liter	Gm. Mols. I_2 per liter
0.0 (= H_2O at pH 5.0)	0.001321
2.0 KNO_3 + 0.0025KI	0.002138
1.65 KCl + 0.10 KI	0.004421

Results are also given for a number of other mixtures of salts.

SOLUBILITY OF IODINE IN AQUEOUS SOLUTIONS OF POTASSIUM IODIDE AT 25°.
(Linhart, 1918.)

Mols. KI per 1000 gms. H ₂ O.....	0.4136	0.5954	0.8065	1.0246
Mols. I ₂ "	0.2313	0.3538	0.5176	0.7079

SOLUBILITY OF IODINE IN VERY DILUTE AQUEOUS SOLUTIONS OF POTASSIUM IODIDE. .

(Determinations made with very great care.)

Results at 0°. (Jones and Hartman, 1915.)			Results at 25°. (Bray and MacKay, 1910.)		Results at 25°. (Noyes and Seidenstricker, 1898.)	
Normality of Aq. KI Sol.	<i>d</i> ₄ ²⁰ of Sat. Sol.	Gms. I per 100 Gms. Sat. Sol.	Normality of Aq. KI Sol.	Millimols I ₂ per Liter Sat. Sol.	Normality of Aq. KI Sol.	Millimols I ₂ per Liter Sat. Sol.
0.000992	1.0002	0.0282	0	1.333	0	1.342
0.00200	1.0004	0.0409	0.001	1.788	0.00083	1.814
0.00500	1.0010	0.0760	0.002	2.266	0.00166	2.235
0.01000	1.0020	0.1356	0.005	3.728	0.00664	4.667
0.01988	1.0044	0.2533	0.010	6.185	0.01329	8.003
0.0500	1.0109	0.609	0.020	11.13	0.02657	14.68
0.09993	1.0219	1.199	0.050	25.77	0.05315	28.03
			0.100	51.35	0.1063	55.28

SOLUBILITY OF IODINE IN AQUEOUS SOLUTIONS OF POTASSIUM IODIDE AT
25° AND VICE VERSA.

(Parsons and Whittemore, 1911.)

(Time of rotation 6 mos. or longer. Duplicate determinations at different lengths of time, were made.)

Sp. Gr. Sat. Sol.	Gms. per 100 Gms. Sat. Sol.		Solid Phase.	Sp. Gr. Sat. Sol.	Gms. per 100 Gms. Sat. Sol.		Solid Phase.
	KI	I			KI	I	
1.349	16.03	18.49	Iodine	3.246	27.92	66.45	KI
1.516	19.70	26.16	"	3.232	29.71	62.81	"
1.769	22.88	36.06	"	2.665	35.80	49.61	"
1.910	23.55	40.52	"	2.539	38.09	44.58	"
2.403	24.78	53.60	"	2.216	44.82	31.01	"
2.904	25	63.12	"	2.066	49.04	23.08	"
3.082	25.18	66.04	"	1.888	54.41	11.63	"
3.316	26	68.09	" + KI	1.733	60.39	0	"

Additional data for this system are given by Bruner, 1898; Hamberger, 1906; and Lami, 1908.

Data for the solubility of iodine in aq. 40% ethyl alcohol and aq. 60% ethyl alcohol solutions of potassium iodide at 25°, are given by Parsons and Corliss, 1910. The solid phases were identified in each case and it was demonstrated that no polyiodides of potassium exist in the solid phase or in solution at 25°.

An extensive series of determinations of the simultaneous solubility of iodine and potassium iodide in nitrobenzene and in other organic solvents, as well as in mixtures of nitrobenzene and other solvents are given by Dawson and Gawler, 1902, and Dawson, 1904. The determinations were made to obtain information on the formation of polyiodides in solution. The molecular ratio of dissolved I₂/KI was found to be 1 or more in all cases.

A review of the evidence for and against the existence of potassium tri iodide is given by Bancroft, Scherer and Gould, 1931. The authors verified one of the results (analysis No. 8) of Parsons and Whittemore, 1911, of which there appeared some doubt. This was done by adding an excess of either iodine, potassium iodide or so-called potassium tri iodide to a synthetically prepared solution corresponding to the quadruple point of the system. No change in the composition of the solution occurred. From this and other evidence it was concluded that potassium tri iodide does not exist at 25°.

For additional results upon the system I + KI see under Potassium Iodide.

SOLUBILITY OF IODINE IN AQUEOUS SOLUTIONS OF POTASSIUM IODIDE AT 25°.
(Reichstein, Ewentow and Kasarnowsky, 1933.)

d $\frac{25}{4}$ of sat. sol.	Gm. Mols. KI per liter	Ratio I KI	d $\frac{25}{4}$ of sat. sol.	Gm. Mols. KI per liter	Ratio I KI
1.008	0.055	0.96	1.776	2.870	2.09
1.025	0.136	1.00	1.889	3.281	2.23
1.055	0.273	1.08	1.900	3.315	2.25
1.095	0.541	1.15	2.006	3.647	2.34
1.255	1.052	1.39	2.090	4.024	2.45
1.335	1.330	1.50	2.200	4.376	2.56
1.390	1.551	1.59	2.289	4.710	2.69
1.508	1.985	1.74	2.357	5.030	2.82
1.512	2.001	1.75	2.390	5.160	2.83
1.652	2.448	1.91	2.504	5.630	2.98
1.760	2.809	2.07	2.640	6.259	3.17

The mixtures were rotated constantly for 200 hours. The saturated solutions were analyzed by diluting an unweighed portion of the filtered solution with water and distilling the free iodine into KI solution. This was titrated with thio sulfate and the fixed iodine remaining in the distilling flask titrated with silver nitrate according to Volhard. The densities of the saturated solutions were measured in a 1.5cc pycnometer. The authors also give results in the form of a diagram showing the effect of additions of sugar upon the ratio of I_2/KI at different KI concentrations. The presence of sugar increases the solubility of I at low concentrations of KI and diminishes it at high concentrations.

EQUILIBRIUM IN THE SYSTEM IODINE, POTASSIUM IODIDE AND
WATER IN THE REGION OF LOW WATER CONCENTRATION AT 25°.

(Grace, 1931.)

The mixtures were initially heated to about 50° and then rotated at 25° for one month. Both the sat. solution and moist solid phases were analyzed. The diagram and the analyses confirm the existence of the two polyiodides $KI_3 \cdot H_2O$ and $KI_7 \cdot H_2O$.

Gms. per 100 gms. sat. solution			Solid Phase	Gms. per 100 gms. sat. solution			Solid Phase
I_2	KI	H_2O		I_2	KI	H_2O	
57.83	32.18	9.96	KI	66.65	27.04	6.38	$KI_7 \cdot H_2O$
61.97	30.25	7.83	" + $KI_3 \cdot H_2O$	67.34	26.52	6.20	"
63.40	29.09	7.45	$KI_3 \cdot H_2O$	68.02	26.00	6.00	" + I
63.88	28.92	7.16	"	65.98	25.08	—	I
64.85	28.36	6.87	"				
66.10	27.26	6.59	" + $KI_7 \cdot H_2O$				

The author also gives several experiments upon equilibrium in the non aqueous solvents, tetra chlor ethane and benzene.

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SOLUBILITY OF IODINE IN AQUEOUS SOLUTIONS OF POTASSIUM BROMIDE
AND OF SODIUM BROMIDE AT 25°.

(Bell and Buckley, 1912.)

IODINE I

In Aq. KBr Solutions.		In Aq. NaBr Solutions.	
Gms. KBr per Liter.	Gm. Atoms I per Liter.	Gms. NaBr per Liter.	Gm. Atoms I per Liter.
60.6	0.0176	96.4	0.0266
106.9	0.0278	187.7	0.0425
175.9	0.0415	271.8	0.0538
229.8	0.0532	357.4	0.0598
281.9	0.0628	422.21	0.0638
330.6	0.0717	499.1	0.0648
377.1	0.0797	569.9	0.0644
411	0.0864	632	0.0622
461.7	0.0948	679.7	0.0595
509.8	0.1006	750.5	0.0551
567.9 sat.	0.1094	756.1 sat.	0.0550

SOLUBILITY OF IODINE IN AQUEOUS SOLUTIONS OF SODIUM CHLORIDE AND OF
SODIUM NITRATE. (Carter, 1925.)

Results for Sodium Chloride
at 25°.

Results for Sodium Nitrate
at 25°.

Wt. per cent NaCl.	Gm. mols. I ₂ per 1000 gm. mols. H ₂ O.	Wt. per cent NaNO ₃ .	Gm. mols. I ₂ per 1000 gm. mols. H ₂ O.	Wt. per cent NaNO ₃ .	Gm. mols. I ₂ per 1000 gm. mols. H ₂ O.
4.52	0.04403	5.89	0.0222	1.98	0.0327
7.43	0.05295	11.10	0.0202	3.48	0.0320
14.14	0.06289	15.31	0.0185	6.85	0.0302
20.31	0.06311	25.67	0.0145	15.89	0.0268
23.15	0.06105	29.75	0.0125	29.06	0.0201
25.95	0.05790	35.43	0.0108	40.17	0.0143
		39.83	0.00911	50.1	0.0100
		44.16	0.00753		

I

SOLUBILITY OF IODINE IN AQUEOUS SODIUM IODIDE SOLUTIONS.

(Gill, 1913-14.)

Aqueous NaI solutions were prepared by dissolving the stated amounts of the salt in water and diluting to 100 cc. An excess of iodine was added to each of these solutions, the mixtures heated to 60° and shaken for several minutes. They were then allowed to cool in a thermostat at 25° for four hours. The dissolved iodine in weighed amounts of the saturated solutions was titrated with thiosulfate. The densities of the Aq. NaI mixtures and also of the solutions after saturation with iodine were determined.

Gms. NaI per 100 cc. Aq. Solution.	d_{25} of Aq. NaI Solution.	d_{25} of Aq. NaI after Saturation with I.	Gms. I Dissolved at 25° per 100 Gms. of the Sat. Sol.
5	1.0369	1.0698	4.99
10	1.0720	1.1415	9.96
15	1.1072	1.2162	14.93
20	1.1458	1.2998	20.02

Determinations at other temperatures were made in an apparatus which permitted constant stirring of the solutions at the several temperatures. Results, interpolated from the original, are as follows:

t°.	Gms. I Dissolved per 100 Gms. Sat. Solution in Aq. NaI of:		t°.	Gms. I Dissolved per 100 Gms. Sat. Solution in Aq. NaI of:	
	10 Gms. per 100 cc.	20 Gms. per 100 cc.		10 Gms. per 100 cc.	20 Gms. per 100 cc.
10	8.9	17.6	30	10.3	20.5
15	9.3	18.3	40	10.9	22
20	9.6	19	50	11.7	23.4
25	10	19.4	60	12.6	24.9

I IODINE

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SOLUBILITY OF IODINE IN AQUEOUS SODIUM IODIDE ALONE AND CONTAINING SODIUM SULFATE AT 25°.

(Carter, 1928.)

Results for:

Aq. NaI Solutions		Aq. NaI + Na ₂ SO ₄ Solutions		
Gm. Mols. per 1000 gms. H ₂ O		Gm. Mols. per 1000 gms. H ₂ O		Gm. Mols. I ₂ per 1000 gms. H ₂ O
NaI	I ₂	NaI	Na ₂ SO ₄	
0.0	0.001324	0.000251	1.698	0.000413
0.000392	0.001494	0.000655	"	0.000497
0.000784	0.001676	0.001431	"	0.000666
0.001959	0.002260	0.003271	"	0.001048
0.003918	0.003199	0.006531	"	0.001738
0.007838	0.005126	0.01274	"	0.003063
0.01959	0.01096	0.02619	"	0.006031
		0.05253	"	0.01190

SOLUBILITY OF IODINE IN AQUEOUS SOLUTIONS OF MONO SODIUM PHOSPHATE AND OF SODIUM SULFATE. (Carter, 1925.)

Results for NaH₂(PO₄)₂
at 25°.

Results for Na₂SO₄
at 25°.

at 35°.

I

Wt. per cent NaH ₂ (PO ₄) ₂	Gm. mols. I ₂ per 1000 gms. H ₂ O.	Wt. per cent Na ₂ SO ₄	Gm. mols. I ₂ per 1000 gms. H ₂ O.	Wt. per cent Na ₂ SO ₄	Gm. mols. I ₂ per 1000 gms. H ₂ O.
7.53	0.0194	5.66	0.0173	1.05	0.0318
14.40	0.0161	8.64	0.0144	4.93	0.0252
20.64	0.0135	16.24	0.00855	9.13	0.0202
26.4	0.0111	19.66	0.00656	14.79	0.0133
31.66	0.00893			21.10	0.00839
41.06	0.0043			25.31	0.00585
45.26	0.0018			33.10	0.00258

SOLUBILITY OF IODINE IN AQUEOUS SALT SOLUTIONS AT 25°.

(McLauchlan, 1903.)

Salt.	Gms. Salt per Liter.	Gms. Dissolved I per Liter.	[Salt.	Gms. Salt. per Liter.	Gms. Dissolved I per Liter.
Na ₂ SO ₄	29.77	0.160	NH ₄ Cl	53.4	0.735
K ₂ SO ₄	43.5	0.238	NaBr	103	3.29
(NH ₄) ₂ SO ₄	33	0.246	KBr	119	3.801
NaNO ₃	85	0.257	NH ₄ Br	98	4.003
KNO ₃	101.2	0.266	NH ₄ C ₂ H ₃ O ₂	77.1	0.440
NH ₄ NO ₃	80	0.375	(NH ₄) ₂ C ₂ O ₄	86.9	0.980
NaCl	58.5	0.575	H ₃ BO ₃	55.8	0.300
KCl	73.6	0.658			

SOLUBILITY OF IODINE IN AQUEOUS ETHYL AND NORMAL PROPYL ALCOHOL SOLUTIONS AT 15°.

(Bruner, 1898.)

In Aq. Ethyl Alcohol.

In Aq. (n.) Propyl Alcohol.

Vol. % C ₂ H ₅ OH in Solvent.	Gms. I per 100 cc. Solution.	Vol. % C ₂ H ₅ OH in Solvent.	Gms. I per 100 cc. Solution.	Vol. % C ₃ H ₇ OH in Solvent.	Gms. I per 100 cc. Solution.	Vol. % C ₃ H ₇ OH in Solvent.	Gms. I per 100 cc. Solution.
10	0.05	60	1.14	10	0.05	60	2.71
20	0.06	70	2.33	20	0.11	70	4.10
30	0.10	80	4.20	30	0.40	80	6.05
40	0.26	90	7.47	40	0.94	90	9.17
50	0.88	100	15.67	50	1.64	100	14.93

SOLUBILITY OF IODINE IN AQUEOUS SOLUTIONS OF ETHYL ALCOHOL AT 15°.
(Schoorl and Regenbogen, 1919.)

Due to the ready formation of HI, accurate determinations of the solubility of iodine in aqueous alcohol can be made best by diluting a solution of iodine in absolute alcohol with water, and determining immediately the C_2H_5OH and iodine content of the resulting solution. At concentrations of alcohol less than 18 per cent the addition of water does not precipitate iodine from its saturated solution. The maximum precipitation of iodine occurs when just enough water is added to bring the alcohol concentration to 18 per cent.

The determinations were plotted and the following values read from the curve.

Wt. per cent C_2H_5OH in aq.-alc. solvent.	Gms. I per 100 gms. solvent.	Wt. per 100 C_2H_5OH in aq.-alc. solvent.	Gms. I per 100 gms. solvent.	Wt. per 100 C_2H_5OH in aq.-alc. solvent.	Gms. I per 100 gms. solvent.
0.0	0.025	35.0	0.35	70.0	4.3
5.0	0.033	40.0	0.55	75.0	5.6
10.0	0.045	45.0	0.80	80.0	7.2
15.0	0.06	50.0	1.20	85.0	9.0
20.0	0.08	55.0	1.70	90.0	11.4
25.0	0.11	60.0	2.30	95.0	14.8
30.0	0.20	65.0	3.20	100.0	20.0

SOLUBILITY OF IODINE IN AQUEOUS ETHYL ALCOHOL AND IN AQUEOUS ACETIC
ACID SOLUTIONS AT 25°.
(McLauchlan, 1903.)

In Aq. C_2H_5OH Solutions.

Gms. C_2H_5OH per 100 Gms. Solvent.	Gms. I per 100 cc. Sat. Solution.
0	0.034
4.55	0.039
28.48	0.172
44.41	0.955
72.51	6.698
100	24.548

In Aq. CH_3COOH Solutions.

Gms. CH_3COOH per 100 Gms. Solvent.	Gms. I per 100 cc. Sat. Solution.
0	0.034
20	0.076
39.5	0.173
61.1	0.510
80.7	1.363
100	3.162

Since McLauchlan's value for the solubility of iodine in water was apparently too low, the figure 0.034 gm. per 100cc was substituted and used as a basis for calculating the remaining results for the solubility of iodine in aqueous alcohol and acetic acid.

SOLUBILITY OF IODINE IN ETHYL ALCOHOL CONTAINING
ONLY SMALL AMOUNTS OF WATER.

(Delepine and Arquet, 1929.)

t°	Wt. Percent C_2H_5OH in Solvent	Gms. I per 100 gms. sat. Solution	t°	Wt. Percent C_2H_5OH in Solvent	Gms. I per 100 gms. sat. Solution
15	85	6.50	24.5	85	7.97
"	90	8.50	"	90	10.2
"	95	12.5	"	95	14.8
"	99.8	18.7	"	99.8	21.0

Several determinations of the reciprocal solubility of Iodine, Ethyl Ether and Water at 20° are given by Nesteroro and Petine, 1931.

100 gms. Glycerol of $d = 1.2326$ (= 86.5%) dissolve 0.47 gm. I at 20°.
 " " " $d = 1.2645$ (= 98.5%) " 0.67 " " " "
 " (Holm, 1921-1922.)
 100 gms. Glycerol of $d_{15} = 1.256$ dissolve 2.0 gm. I at 15-16°.
 (Ossendowski, 1907.)

SOLUBILITY OF IODINE IN AQUEOUS GLYCEROL SOLUTIONS AT 25°.
(Herz and Knoch, 1905.)

Density of glycerine at 25°/4° = 1.2555; impurities about 1.5%.

Wt. % Glycerine in Solvent.	Millimols I per 100 cc. Solution.	Grams I per 100 cc. Solution.	Density of Solutions at 25°/4°.
0	0.24	0.0304	0.9979
7.15	0.27	0.0342	1.0198
20.44	0.38	0.0482	1.0471
31.55	0.49	0.0621	1.0750
40.95	0.69	0.0875	1.0995
48.7	1.07	0.135	1.1207
69.2	2.20	0.278	1.1765
100.0	9.70	1.223	1.2646

EQUILIBRIUM IN THE SYSTEM IODINE, PYRIDINE AND WATER AT 18°.
(Chatelet, 1934.)

The solubility of iodine in pyridine was found to be about 450 gms. I per 100cc of sat. solution at 18°. From such a solution upon evaporation, clear yellow needles separate, but within 2-5 minutes they begin to decompose with liberation of iodine.

In the case of the mixtures of iodine, pyridine and water they were agitated about 15 minutes and then filtered through a porous glass disc. The clear filtrate and several samples of the mixture of solid and solution were analyzed. The results when plotted indicate the formation to two molecular compounds.

Gms. per 100 gms. sat. solution			Solid Phase
I ₂	C ₅ H ₅ N	H ₂ O	
3.6	47.5	48.9	I ₂ (C ₅ H ₅ N) ₂ ·29(?)H ₂ O
1.0	33.9	65.1	"
1.5	24.1	74.1	"
2.7	9.0	88.3	I ₂ (C ₅ H ₅ N)·6H ₂ O
2.0	8.4	89.6	"
1.1	6.1	92.8	"

DISTRIBUTION OF IODINE BETWEEN WATER AND BROMOFORM, WATER AND CARBON DISULFIDE, AND WATER AND CARBON TETRACHLORIDE AT 25°.
(Jakowkin, 1895.)

The original results were plotted on cross-section paper and the following table made from the curves. Jakowkin points out that the results of Berthelot and Jungfleisch, 1872, are incorrect on account of the presence of HI.

Gms. I per Liter of H ₂ O Layer in Each Case.	Gms. I per Liter of:		
	CHBr ₃ Layer.	CS ₂ Layer.	CCl ₄ Layer.
0.05	20	30	4
0.10	45	60	8.5
0.15	71	91	13
0.20	100	126	17.5
0.25	130	160	22

A theoretical discussion of the results of Jakowkin is given by Schükarew (1901).

DISTRIBUTION OF IODINE BETWEEN WATER AND CARBON TETRACHLORIDE AT 25°.

Results of Linhart, 1918.

Gm. mols. I ₂ per 1000 gms.		C
H ₂ O layer (W).	CCl ₄ layer (C).	W
0.000402	0.022988	57.2
0.000623	0.035260	56.6
0.000724	0.040828	56.4
0.000754	0.043020	57.1
0.000907	0.051304	56.6

Results of Pearce and Eversole, 1924.

Gms. I ₂ per 1000 gms.		C
H ₂ O layer (W).	CCl ₄ layer (C).	W
0.0745	3.8990	52.35
0.1020	5.3584	52.53
0.1078	5.6775	52.64
0.1432	7.5145	52.49
0.2432	12.6950	52.21

Data for the distribution of iodine between aqueous solutions of barium iodide and carbon tetrachloride at 25° are given by Pearce and Eversole, 1924.

Data for the distribution of iodine between aqueous solutions of hydrobromic acid and carbon tetrachloride at 30°, and between aqueous solutions of hydrochloric acid and carbon disulfide at 25° are given by Rây and Sarkar, 1922.

Data for the distribution of Iodine between aqueous solutions of sodium iodide (0.4933 and 0.994 gm. mols. per liter) and carbon tetrachloride at 25° are given by Carter, 1928.

DISTRIBUTION OF IODINE (WHEN AN EXCESS IS PRESENT) AT 25° BETWEEN :
(Schilow and Lepin, 1922.)

Water and Chloroform.

Gms. I per 100 cc. saturated		C
H ₂ O layer (W).	CHCl ₃ layer (C).	W
0.0425	2.97	70

Water and Toluene.

Gms. I per 100 cc. saturated		T
H ₂ O layer (W).	Toluene layer T.	W
0.036	3.50	97.5

DISTRIBUTION OF IODINE BETWEEN:
(Herrero, 1931, 1932, 1936.)

Water and Carbon Tetrachloride at 20° Water and Carbon Disulfide at 25°

Gms. I per liter of:		C
CCl ₄ layer (c)	H ₂ O layer (w)	W
1.2722	0.0169	75.1
2.0856	0.0273	76.2
3.0241	0.0391	77.3
5.2244	0.0651	80.16
7.6124	0.0938	81.1
9.9587	0.1199	83.0
15.4491	0.1825	84.7

Gms. I per liter of:		C
CS ₂ layer (c)	H ₂ O layer (w)	W
41.3694	0.06979	592
60.1506	0.09999	602
78.6780	0.12994	605
85.6575	0.14009	611
98.4744	0.15862	620
126.1386	0.20100	627
137.5596	0.21496	639
152.7876	0.23476	650

The author found that the solubility of iodine in water is not appreciably affected by the presence of carbon disulfide. He found 0.2691 gms. I per liter pure water at 18° and 0.2876 gms. at 20°. Practically identical figures were obtained when water sat. with CS₂ was used instead of pure water.

I IODINE

666 DISTRIBUTION OF IODINE AT 20° BETWEEN: (Herrero, 1933.)

Water and Ethylene Bromide			Water and Trichlor Ethylene		
Gms. I per liter of:		$\frac{c}{w}$	Gms. I per liter of:		$\frac{c}{w}$
CH_2Br_2 layer (c)	H_2O layer (w)		CCl_3 layer (c)	H_2O layer (w)	
20.40	0.03137	650	2.749	0.02499	110
39.12	0.05881	665	5.098	0.04498	113
62.46	0.09149	683	7.748	0.06623	117
92.29	0.13331	692	10.872	0.07873	119
127.43	0.18298	696	17.033	0.14246	119.6
			22.832	0.18870	121
			30.242	0.24994	121

1000cc sat. solution of Iodine in Ethylene Bromide contain 201.03 gms. I at 20°.

1000cc sat. solution of Iodine in Trichlor Ethylene contain 38.78 gms. I at 20°. (Herrero, 1933.)

DISTRIBUTION OF IODINE AT 20° BETWEEN: (Herrero, 1933.)

Water and Benzene Water and Nitrobenzene

I	Gms. I per liter of:		$\frac{c}{w}$	Gms. I per liter of:		$\frac{c}{w}$
	C_6H_6 layer (c)	H_2O layer (w)		$\text{C}_6\text{H}_5\text{NO}_2$ layer (c)	H_2O layer (w)	
	12.972	0.03499	368	10.28	0.05230	196
	20.432	0.05498	371	14.38	0.07371	195
	41.240	0.10997	375	19.00	0.09593	198
	56.261	0.14621	385	23.17	0.11815	196
	79.984	0.20245	395	31.06	0.15762	196
	90.633	0.22494	403	37.98	0.19343	196
	97.226	0.23869	407	44.14	0.22532	196
	105.749	0.25868	409			

1000cc sat. solution of Iodine in Benzene contain 119.343 gms. I at 20°.
" " " " " " nitrobenzene " 56.465 " " " "

(Herrero, 1933)

DISTRIBUTION OF IODINE AT ROOM TEMPERATURE BETWEEN AQUEOUS STARCH SOLUTIONS AND CHLOROFORM. (Firth and Watson, 1922.)

Ten cc. of a chloroform solution of iodine was shaken with 10 cc. of the starch solution for 10 minutes and, after separation of the two layers, the iodine remaining in the CHCl_3 layer was determined by titration with standard thiosulfate solution.

Gms. I per liter in the starch solution containing				
Gms. I per liter in the original CHCl_3 sol.	4 gms. starch per liter.	2 gms. starch per liter.	1 gm. starch per liter.	0.5 gm. starch per liter.
0.15204	0.02534	0.015175	0.007587	0.004434
0.1267	0.02281	0.011405	0.006335	0.003794
0.11403	0.02154	0.010135	0.006335	0.003167
0.10136	0.02027	0.010135	0.005712	0.002534
0.08869	0.01901	0.009505	0.005068	0.002534
0.07602	0.01584	0.008235	—	—

The results show that the amount of iodine withdrawn from the CHCl_3 is proportional to the concentration of the starch. The authors also give results showing the effect of various amounts of KI in the starch solution upon the amount of iodine withdrawn from the CHCl_3 .

DISTRIBUTION OF IODINE BETWEEN CARBON DISULFIDE AND
AQ. POTASSIUM OXALATE.

(Dawson — Z. physik. Chem. 56, 610, '06; Dawson and McRae — J. Chem. Soc. 81, 1086, '02.)

Concentration of Aq. $K_2C_2O_4$. I.O. Equiv.	Gms. I per Liter of		Vol. of Solution which Contains 1 Mol. I.	Fraction of I Uncombined in Solution.
	Aq. Layer.	CS_2 Layer.		
1.0	2.408	10.82	105.3	0.005495
1.0	3.555	16.32	71.37	0.00561
1.0	5.766	27.91	43.99	0.005915
1.0	6.861	34.01	36.98	0.006055
1.2	3.525	17.07	71.97	0.005645

DISTRIBUTION OF IODINE BETWEEN AMYL ALCOHOL AND WATER AND
BETWEEN AMYL ALCOHOL AND AQUEOUS POTASSIUM IODIDE
SOLUTIONS AT 25°.

(Herz and Fischer — Ber. 37, 4752, '04.)

The original results were plotted on cross-section paper, and the following tables made from the curves.

Millimols I per 10 cc. Amyl Alcohol Layer in Each Case.	Millimols I per 10 cc. of H_2O and of Aq. KI Layers.					
	H_2O .	$\frac{N}{10}$ KI.	$\frac{2N}{10}$ KI.	$\frac{3N}{10}$ KI.	$\frac{4N}{10}$ KI.	$\frac{10N}{10}$ KI.
2.5	0.012	0.135	0.160	0.170	0.170	...
3.0	0.014	0.150	0.185	0.200	0.200	0.160
4.0	0.018	0.180	0.235	0.255	0.270	0.240
5	0.021	0.210	0.280	0.315	0.340	0.315
6	0.025	0.230	0.330	0.375	0.410	0.390
7	0.029	0.250	0.375	0.430	0.480	0.470
8	...	0.260	0.420	0.490	0.550	0.555
9	...	0.270	0.450	0.550	0.620	0.640
10	...	0.280	0.470	0.605	0.690	0.720
12	...	...	0.490	0.700	0.830	0.900
14	...	...	0.510	0.790	0.980	1.200
20	...	...	0.575	...	...	...

I

Gms. I per 100 cc. Amyl Alcohol Layer in Each Case.	Gms. I per 100 cc. of H_2O and of KI Layers.					
	H_2O .	$\frac{N}{10}$ KI.	$\frac{2N}{10}$ KI.	$\frac{3N}{10}$ KI.	$\frac{4N}{10}$ KI.	$\frac{10N}{10}$ KI.
3	0.014	0.164	0.20	0.21	0.21	...
4	0.016	0.196	0.24	0.26	0.26	0.21
6	0.026	0.252	0.34	0.38	0.40	0.37
8	0.033	0.297	0.43	0.49	0.54	0.51
10	0.040	0.328	0.51	0.61	0.67	0.69
12	...	0.341	0.58	0.73	0.81	0.84
14	...	...	0.60	0.83	0.95	1.00
16	...	...	0.63	0.91	1.09	1.20
18	...	...	0.64	...	...	...
25	...	...	0.71	...	...	...

The original figures for $5N/10$ and $10N/10$ KI solutions give practically identical curves.

Results for the distribution of Iodine between $N/10$ KI solutions on the one hand, and mixtures in various proportions of C_6H_6 + CS_2 , $C_6H_5CH_3$ + CS_2 , C_6H_6 + $C_6H_5CH_3$, C_6H_6 + light petroleum, CS_2 + light petroleum, CS_2 + $CHCl_3$, $CHCl_3$ + C_6H_6 , CCl_4 + CS_2 , and CCl_4 + $C_6H_5CH_3$, on the other hand, are given by Dawson — J. Chem. Soc., 81, 1086, '02.

DISTRIBUTION OF IODINE BETWEEN WATER AND IMMISCIBLE ORGANIC SOLVENTS.

Results for Water + Carbontetra- chloride at 18°. (Dawson, 1908.)	Results for Water + Nitrobenzene at 18°. (Dawson, 1908.)	Results for Water + Carbon Disul- fide at 15°. (Dawson, 1902.)	Results for Water + Chloroform at 25°. (Herz & Kurzer, 1910.)
Mols. Iodine per Liter.	Mols. Iodine per Liter.	Gms. Iodine per Liter.	Mols. Iodine per Liter.
H ₂ O Layer. CCl ₄ Layer.	H ₂ O Layer. C ₆ H ₅ NO ₂ Layer.	H ₂ O Layer. CS ₂ Layer.	H ₂ O Layer. CHCl ₃ Layer.
0.000416 0.0344	0.00019 0.0333	0.0452 27.85	0.00025 0.0338
0.000535 0.0443	0.00050 0.0854	0.0486 30.09	0.00120 0.1546
	0.00133 0.2275	0.0486 30.31	0.00184 0.2318
	0.00189 0.3328		0.00259 0.3439
Results for Water + Trichlorethyl- ene at 25°. (Herz & Rathmann, '13.)	Results for Water + Tetrachlor- ethylene at 25°. (Herz & Rathmann, '13.)	Results for Water + Tetrachlor- ethane at 25°. (Herz & Rathmann, '13.)	Results for Water + Pentachlor- ethane at 25°. (Herz & Rathmann, '13.)
Mols. Iodine per Liter.	Mols. Iodine per Liter.	Mols. Iodine per Liter.	Mols. Iodine per Liter.
H ₂ O Layer. CHCl ₂ .CCl ₃ Layer.	H ₂ O Layer. CCl ₂ .CCl ₂ Layer.	H ₂ O Layer. C ₂ H ₂ Cl ₄ Layer.	H ₂ O Layer. C ₂ HCl ₃ Layer.
0.00046 0.0543	0.00088 0.0653	0.00119 0.1101	0.00092 0.0848
0.00070 0.0778	0.00127 0.0932	0.00145 0.1247	0.00117 0.1067
0.00112 0.1275	0.00172 0.1285	0.00159 0.1479	0.00160 0.1434
0.00236 0.2672	0.00281 0.2161	0.00217 0.2103	0.00204 0.1963

Data for the distribution of iodine between water and mixtures of CS₂+CCl₄ at 25° are given by Herz and Kurzer, 1910.

Data for the distribution of iodine between carbon disulfide and aqueous solutions of each of the following iodides at 25° are given by van Name and Brown, 1917. Cadmium iodide, cadmium potassium iodide, lanthanum iodide, nickel iodide, strontium iodide, zinc iodide and zinc potassium iodide. Results for the distribution of iodine between carbon tetrachloride and aq. mercuric potassium iodide are also given.

Results for distribution between CS₂ and aq. BaI₂ sols. are given by Herz and Kurzer, 1910.

Data for the distribution of iodine between carbon disulfide and aqueous solutions of potassium iodide at 15° and at 13.5°, and between carbon disulfide and aqueous solutions of hydriodic acid at 13.5°, are given by Dawson, 1901 and 1902.

Data for the distribution of iodine between carbon tetrachloride and aqueous solutions of mercuric bromide and of mercuric chloride at 25° are given by Herz and Paul, 1914.

DISTRIBUTION OF IODINE BETWEEN CARBON DISULFIDE AND AQ. ETHYL ALCOHOL AT 25°. (Osaka, 1903-08.)

Gms. C ₂ H ₅ OH per 100 cc. Aq. Alcohol.	Gms. Iodine per Liter: CS ₂ Layer Aq. Alcohol c. Layer c.	$\frac{c}{c'}$	Gms. C ₂ H ₅ OH per 100 cc. Aq. Alcohol.	Gms. Iodine per Liter: CS ₂ Layer Aq. Alcohol c. Layer c.	$\frac{c}{c'}$
7.6	0.072 35.86	0.0020	19.1	0.330 97	0.0034
7.6	0.211 107.79	0.0020	22.9	0.115 23.78	0.0048
11.4	0.077 32.93	0.0023	22.9	0.418 89.61	0.0047
11.4	0.280 133.22	0.0021	26.7	0.0756 9.8	0.0077
15.3	0.075 25.61	0.0029	26.7	0.495 65.10	0.0076
15.3	0.315 115.34	0.0027	30.5	0.0636 4.90	0.0130
19.1	0.045 13.42	0.0034	30.5	0.546 42.27	0.0129

DISTRIBUTION OF IODINE BETWEEN ETHER AND ETHYLENE GLYCOL. (Landau, 1910.)

Results at 0°.			Results at 25°.		
Gms. Iodine per Liter: (C ₂ H ₅) ₂ O Layer (a).	(CH ₂ OH) ₂ Layer (b).	$\frac{a}{b}$	Gms. Iodine per Liter: (C ₂ H ₅) ₂ O Layer (a).	(CH ₂ OH) ₂ Layer (b).	$\frac{a}{b}$
2.139	1.449	1.48	2.208	1.449	1.52
7.820	4.347	1.80	4.255	2.541	1.60
16.620	9.486	1.75	7.728	4.347	1.78
20.564	11.685	1.76	16.200	9.120	1.78
31.785	18.135	1.75	30.322	17.062	1.78
79.950	44.460	1.80	78.195	44.460	1.76

DISTRIBUTION OF IODINE BETWEEN GLYCEROL AND BENZENE AND BETWEEN GLYCEROL AND CARBON TETRACHLORIDE.

(Landau, 1910.)

Results for Glycerol and Benzene.

t°.	Grams Iodine per Liter:		(b) (a)
	Glycerol Layer. (a)	Benzene Layer. (b)	
25°	0.407	1.922	4.72
"	0.676	4.086	6.04
"	1.470	10.212	6.95
"	2.622	20.102	7.67
"	5.280	42.458	8.04
40°	0.459	2.168	4.72
"	0.658	3.911	5.94
"	1.584	11.244	7.10
"	3.048	24.104	7.91
"	5.564	46.960	8.44
50°	0.467	2.194	4.70
"	0.642	3.864	6.02
"	1.463	11.196	7.65
"	2.391	19.872	8.31
"	5.383	46.782	8.69

Results for Glycerol and CCl₄.

t°.	Gms. Iodine per Liter:		(b) (a)
	Glycerol Layer. (a)	CCl ₄ Layer. (b)	
25°	0.365	0.565	1.55
"	0.684	1.224	1.78
"	1.416	2.652	1.87
"	5.064	9.888	1.95
"	7.636	14.766	1.93
40°	0.322	0.575	1.79
"	0.690	1.169	1.74
"	1.224	2.772	1.69
"	2.832	6.444	2.26
"	6.854	15.410	2.25
50°	0.299	0.653	2.19
"	0.570	1.270	2.23
"	1.511	3.457	2.29
"	2.664	6.468	2.43
"	6.348	16.008	2.52

DISTRIBUTION OF IODINE BETWEEN GLYCEROL AND CHLOROFORM.

Results at 25°.

(Herz & Kurzer, 1910.)

Mols. Iodine per 1000 Gms.		
Glycerol Layer c.	CHCl ₃ Layer c'.	c/c'.
0.0244	0.0564	0.43
0.0397	0.0919	0.43
0.0500	0.1151	0.43

Results at 30°.

(Hantzsch & Vagt, 1901.)

Mols. Iodine per Liter:		
Glycerol Layer c.	CHCl ₃ Layer c'.	c/c'.
0.00097	0.00172	0.056
0.00204	0.00412	0.495
0.00418	0.00808	0.465
0.00782	0.0216	0.362

Results at Dif. Temps.

(Hantzsch & Vagt, 1901.)

t°.	Mols. I per Liter:		c/c'.
	Glycerol Layer c.	CHCl ₃ Layer c'.	
0	0.0119	0.0177	0.675
20	0.0084	0.0213	0.400
40	0.0077	0.0221	0.349
50	0.0074	0.0226	0.330

Data are also given by the above named investigators for the distribution of iodine between aqueous glycerol solutions and chloroform at several temperatures.

DISTRIBUTION OF IODINE BETWEEN GLYCEROL AND ETHYL ETHER.

(Hantzsch & Vagt, 1901.)

t°.	Mols. Iodine per Liter:		c/c'.
	Glycerol Layer (c).	Ether Layer (c').	
0	0.00566	0.0270	0.21
30	0.00544	0.0272	0.20
30	0.00100	0.0051	0.20

SOLUBILITY OF IODINE IN LIQUID CARBON DIOXIDE.
(Quinn, 1928.)

t°	d of CO ₂	Est. density of sat. sol.	Gm. I per 1 Gm. Mol. CO ₂	Gms. I per 100 gms. CO ₂
-21	1.031 (-20°)	1.031 (-20°)	0.0102	0.0232
-11.4	0.981 (-10)	0.982 (-10)	0.0191	0.0434
0	0.927	0.929	0.0347	0.0788
+10	0.858	0.863	0.0526	0.1195
20	0.770	0.775	0.0774	0.1759
25	0.710	0.720	0.0915	0.2079

SOLUBILITY OF IODINE IN CARBON DISULFIDE.
(Arctowski, 1894.)

t°.	Gms. I per 100 Gms. Solution.	t°.	Gms. I per 100 Gms. Solution.	t°.	Gms. I per 100 Gms. Solution.
-100	0.32	0	7.89	30	19.26
-80	0.51	10	10.51	36	22.67
-63	1.26	15	12.35	40	25.22
-20	4.14	20	14.62	42	26.75
-10	5.52	25	16.92		

SOLUBILITY OF IODINE IN SEVERAL SOLVENTS AT 25°.
(Herz and Rathmann, 1913.)

Solvent.	Iodine per Liter of Sat. Sol.		Solvent.	Iodine per Liter of Sat. Sol.	
	Mols.	Gms.		Mols.	Gms.
Chloroform	0.352	44.68	Trichlorethylene	0.312	39.61
Carbon Tetrachloride	0.237	30.08	Tetrachlorethane	0.244	30.97
Tetrachlorethylene	0.241	30.59	Pentachlorethane	0.272	34.53

SOLUBILITY OF IODINE IN SEVERAL SOLVENTS.
(Margosches, Hinner and Friedmann, 1924.)

t°	Gms. I per 100cc sat. solution in:					
	Carbon Tetrachloride CCl ₄	Chloro- form CHCl ₃	Methylene Chloride CH ₂ Cl ₂	Tetra chloro Ethylene CCl ₂ .CCl ₂	Trichloro Ethylene CHCl.CCl ₂	Di chlor Ethylene CH ₂ CCl ₂
11	1.77	2.84	3.68	1.87	2.48	2.99
15	2.05	3.26	4.22	2.10	2.80	3.38
18	2.25	3.54	4.65	2.32	3.05	3.72
21	2.51	3.95	5.13	2.59	3.41	4.13
25	2.91	4.52	5.86	3.06	3.96	4.76

t°	Gms. I per 100 cc sat. solution in:				
	Pentachloro Ethane CHCl ₂ .CCl ₃	Acetylene Tetra Chloride CHCl ₂ .CHCl ₂	Chloro Ethylene Chloride CH ₂ .CHCl	Ethylene Chloride CH ₂ Cl.CH ₂ Cl	Ethylidene Chloride CH ₃ .CHCl ₂
11	2.02	2.71	3.72	4.59	3.00
15	2.31	3.01	4.15	5.11	3.25
18	2.50	3.22	4.50	5.59	3.49
21	2.80	3.61	4.91	6.13	3.92
25	3.09	4.10	5.47	6.87	4.39

SOLUBILITY OF IODINE IN SEVERAL SOLVENTS.

Solvent	Formula	t°	Gms. Iodine per		Authority
			100 gms. sat. sol.	100 cc sat. sol.	
Acetic Acid	CH_3COOH	20	1.727	—	(Anders, 1933.)
" "	"	30	2.706	—	" "
" "Ethyl Ester	$\text{CH}_3\text{COOC}_2\text{H}_5$	8	11.1	—	(Knott, 1932.)
" " " "	"	11	12.39	—	" "
" " " "	"	30	16.15	—	" "
Carbon Disulfide	CS_2	25	—	23.0	(Jakowkin, 1895)
Carbon Tetrachloride	CCl_4	0	—	1.04	(Groh, 1927.)
" "	"	11.5	—	1.83	" "
" " " "	"	25	—	3.03	(Jakowkin, 1895)
Tetra chlor ethane	$\text{CHCl}_2\cdot\text{CHCl}_2$	25	—	4.16	(Grace, 1931.)
Bromoform	CHBr_3	5.6	3.22	—	(Amadori, 1922.)
" "	"	25	6.6	—	(Turner and English, 1914.)
" "	"	25	—	18.96	(Jakowkin, 1895.)
Benzene	C_6H_6	25	—	13.83	(Grace, 1931.)
" "	"	20	8.15	—	(Anders, 1933.)
" "	"	30	11.64	—	" "
Nitrobenzene	$\text{C}_6\text{H}_5\text{NO}_2$	16-17	—	5.06	(Dawson and Gawler, 1902.)
Toluene	$\text{C}_6\text{H}_5\text{CH}_3$	25	—	3.56	(Schilow and Lepin, 1922.)
Hexane	$\text{CH}_3(\text{CH}_2)_4\text{CH}_3$	25	12.2	—	(Hildebrand and Jenks, 1920.)
Anhy. Lanolin	(m. pt. 46°)	45	5.5	—	(Klose, 1907.)

SOLUBILITY OF IODINE IN CARBON TETRACHLORIDE.

(Jacek, 1926; Hildebrand and Jenks, 1920.)

t°.	Gms. I per 100 gms. CCl_4 .	t°.	Gms. I per 100 gms. CCl_4 .	t°.	Gms. I per 100 gms. CCl_4 .
-24.75....	0.254	-16.5....	0.352	-7.25....	0.527
-24.0....	0.257	-14.5....	0.375	-6.00....	0.539
-22.0....	0.270	-11.25....	0.447	-2.75....	0.632
-19.0....	0.297	-9.5....	0.466	0.0....	0.733
-18.5....	0.319	-8.5....	0.480	0.0....	0.693 (H. and J.)
-17.0....	0.327	-8.25....	0.496	35.0....	2.667 "
				50.0....	4.547 "

SOLUBILITY OF IODINE IN CARBON DISULFIDE. (Jacek, 1915.)

t°.	Gms. I per 100 gms. CS_2 .	t°.	Gms. I per 100 gms. CS_2 .	t°.	Gms. I per 100 gms. CS_2 .
-107.....	0.158	-69.....	0.520	-29.5.....	2.597
-80.....	0.255	-51.....	1.089	-22.25.....	3.541
-77.5....	0.342	-45.....	1.361	-15.75.....	4.544
-71.5....	0.422	-35.25....	2.007	-5.....	6.788
				0.....	8.385

SOLUBILITY OF IODINE IN CHLOROFORM.

(Below 0°, Jacek, 1915; above 0°, Grimbert, Malmy and Poirot, 1924; Malmy, 1926.)

t°.	Gms. I per 100 gms. CHCl ₃ .	t°.	Gms. I per 100 gms. CHCl ₃ .	t°.	Gms. I per 100 gms. CHCl ₃ .
-60.....	0.089	-9.....	0.856	10.....	1.805 (G. M. and P.)
-51.....	0.128	-5.....	1.054	15.....	2.176 »
-45.5.....	0.180	-1.....	1.198 (M.)	19.....	2.533 »
-35.0.....	0.243	0.....	1.240	20.....	2.630 »
-30.....	0.372	0.....	1.237 (M.)	24.....	3.092 »
-25.....	0.404	+0.5...	1.267 (M.)	25.....	3.200 (3.38*)
-22.25....	0.514	5.0...	1.483 (G. M. and P.)	30.....	3.836 (M.)

* Gms. per 100 cc. sat. sol. at 25° (Schilow and Lepin, 1922.)

100 gms. chloroform for anaesthesia, containing 0.005 per cent C₂H₅OH, dissolve 2.19 gm. I at 15°. (G. M. and P.)

SOLUBILITY OF IODINE IN ETHYL ETHER. (Jacek, 1915.)

t°.	Gms. I per 100 gms. (C ₂ H ₅) ₂ O.	t°.	Gms. I per 100 gms. (C ₂ H ₅) ₂ O.	t°.	Gms. I per 100 gms. (C ₂ H ₅) ₂ O.
-108.....	15.10	-51.....	16.44	-21.....	20.38
-94.5.....	15.43	-47.....	17.08	-19.5.....	20.80
-83.25...	15.46	-40.25..	17.67	-14.75...	21.59
-75.....	15.67	-34.75...	18.64	0.0.....	26.08
-63.....	16.16	-24.5....	19.67		

SOLUBILITY OF IODINE IN HEPTANE. (Hildebrand and Jenks, 1920.)

t°.	Gms. I per 100 gms. sat. sol.	Mols. I, per 100 mols. sat. sol.
0.....	0.6176	0.00245
25.....	1.702	0.006786
35.....	2.491	0.00998
50.....	4.196	0.01699

SOLUBILITY OF IODINE IN BENZENE, CHLOROFORM, AND IN ETHER.

(Arctowski — Z. anorg. Chem. 11, 276, '95-'96.)

In Benzene.		In Chloroform.		In Ether.	
t°.	Gms. I per 100 Gms. Solution.	t°.	Gms. I per 100 Gms. Solution.	t°.	Gms. I per 100 Gms. Solution.
4.7	8.08	-49	0.188	-83	15.39
6.6	8.63	-55½	0.144	-90	14.58
10.5	9.60	-60	0.129	-108	15.09
13.7	10.44	-69½	0.089		
16.3	11.23	-73½	0.080		
		+10	1.76 per 100 gms. CHCl ₃		

(Duncan — Pharm. J. Trans. 22, 544, '91-'92.)

SOLUBILITY OF IODINE IN ACETONE AND IN BENZENE.

Results for Acetone.

(Jacek, 1915.)

t°.	Gms. I per 100 gms. CH ₃ .CO.CH ₃ .
-84.....	2.73
-75.....	6.76
-70.5...	8.83
-54.75..	15.06
-53.5...	13.5
-51.0...	12.1
-44.5...	8.6
-42.0...	8.6

t°.	Gms. I per 100 gms. CH ₃ .CO.CH ₃ .
-34.....	6.54
-30.....	5.30
-22.5...	4.5
-18.0...	4.25
-16.0...	3.9
-5.0...	2.66
0.0...	2.56

Results for Benzene.

(Hildebrand and Jenks, 1920.)

t°.	Gms. I per 100 gms. sat. sol.	Mols. I ₂ per 100 mols. sat. sol.
25.....	14.09	0.0480
30.....	16.10	0.0558
35.....	17.90	0.0629
40.....	20.05	0.0716
45.....	22.78	0.0832
50.....	25.51	0.0953
54.64..	28.26	0.1081

SOLUBILITY OF IODINE IN SEVERAL SOLVENTS.

(Negishi, Donnally and Hildebrand, 1933.)

Solvent	t°	Gms. I per 100 gms. sat. sol.	Gm. Mols. I ₂ per 100 gm. mols. sat. sol.
Titanium tetra chloride, TiCl ₄	0.1	1.153	0.8633
" " " "	25.0	2.855	2.150
" " " "	40.0	4.631	3.499
" " " "	49.9	6.500	4.939
Silicon tetra chloride, SiCl ₄	0.1	0.2555	0.1713
" " " "	25.0	0.7433	0.4987
" " " "	40.0	1.309	0.8801
Ethylene Bromide, CH ₂ Br.CH ₂ Br	8.0	6.557	4.925
" " " "	10.0	6.850	5.161
" " " "	15.0	7.859	5.937
" " " "	20.0	9.091	6.895
" " " "	25.0	10.32	7.815
" " " "	35.0	13.42	10.28
" " " "	45.0	17.43	13.51
" " " "	49.6	19.12	14.89
" " " "	60.0	25.54	20.24
" " " "	70.0	33.30	26.97
" " " "	75.0	37.61	30.85
" " " "	78.4	42.40	35.26
Iso Octane, CH ₃ C(CH ₃) ₂ CH ₂ CH (CH ₃) ₃ CH ₃	24.92	1.302	0.590
(2,2,4-tri methyl pentane)"	35.0	1.918	0.8711

In the cases of the titanium and silicon tetrachloride the determinations were made in an atmosphere of nitrogen.

SOLUBILITY OF IODINE IN NORMAL PENTANE AND IN ISO PENTANE.

(Jacek, 1926.)

Results for Normal Pentane.

t°.	Gms. I per 100 gms. CH ₃ (CH ₂) ₄ CH ₃ .	t°.	Gms. I per 100 gms. CH ₃ (CH ₂) ₄ CH ₃ .
-71.25..	0.018	-26.75..	0.160
-69.75..	0.021	-26.0...	0.171
-54.25..	0.042	-15.25..	0.297
-48.75..	0.057	-7.0...	0.423
-45.25..	0.067	-5.5...	0.483
-40.75..	0.078	0.0...	0.605
-34.25..	0.113	+19.0...	1.377

Results for Iso Pentane.

t°.	Gms. I per 100 gms. (CH ₃) ₂ CHCH ₂ CH ₃ .	t°.	Gms. I per 100 gms. (CH ₃) ₂ CHCH ₂ CH ₃ .
-79.25..	0.017	-31.5...	0.117
-66.25..	0.018	-25.25..	0.155
-56.00..	0.033	-23.5...	0.172
-49.0...	0.039	-21.0...	0.200
-42.5...	0.063	-10.0...	0.345
-37.5...	0.080	-8.0...	0.381
-36.95..	0.089	-8.0...	0.375
-34.25..	0.096	0.0...	0.562

I IODINE

 RECIPROCAL SOLUBILITY OF IODINE AND SULFUR IN BENZENE
 AND IN CARBON DISULFIDE AT 25°. (Amadori, 1922.)

Results for Benzene.			Results for Carbon Disulfide.		
Gms. per 100 gms. sat. sol.		Solid Phase.	Gms. per 100 gms. sat. sol.		Solid Phase.
I.	S.		I.	S.	
15.79	0.0	I	19.14	0.0	I
16.08	0.40	»	19.83	7.76	»
16.28	1.75	»	20.64	12.83	»
16.42	2.58	I + S	21.45	27.73	»
12.72	2.42	S	22.11	36.74	»
8.31	2.35	»	22.64	40.82	S + I
0.0	2.09	»	16.08	39.56	S
			9.4	37.12	»
			6.62	36.42	»
			0.0	34.76	»

Data for the reciprocal solubility of iodine and sulfur in carbon disulfide at 10° and at 18° are given by Mori, 1923. This author also found no evidence of the existence of compounds of iodine and sulfur.

Bromoform simultaneously saturated with iodine and sulfur contains 3.7 gms. I and 4.2 gms. S per 100 gms. sat solution at 3.65°. (Amadori, 1922.)

I

 RECIPROCAL SOLUBILITY OF IODINE AND SULFUR IN CARBON TETRACHLORIDE.
 (Jakowkin and Archangelsky, 1936.)

Results at 0°			Results at 25°		
Gms. per 100cc sat. sol.		Solid Phase	Gms. per 100cc sat. sol.		Solid Phase
I	S		I	S	
1.145	0.0	I	2.905	0.0	I
1.157	0.596	I + S	3.083	1.466	I + S
0.818	0.596	S	2.069	1.405	S
0.0	0.596	S	1.998	1.394	S
			0.0	1.329	S

Solubility results on mixtures of Iodine and Potassium Iodide with Chloroform and with Toluene, given by Foote and Bradley, 1932, show that between 0.7° and 25.0° no solid binary addition product of Iodine and Potassium Iodide exists. With benzene a ternary addition product having the composition $KI \cdot 4I_2 \cdot 3C_6H_6$ was found.

SOLUBILITY OF IODINE IN NITROBENZENE SOLUTIONS CONTAINING VARIOUS IODIDES AT ROOM TEMPERATURE. SOLUTIONS SAT. WITH I IN EACH CASE.

(Dawson and Goodson, 1904.)

Iodide.	Gms. per Liter.		Iodide.	Gms. per Liter.	
	Iodide.	Iodine.		Iodide.	Iodine.
Potassium Iodide	12.35	112.7	Caesium Iodide*	48.2	213
" "	45.56	205.7	Caesium Iodide	223	858
" "	115.8	698.2	Ammonium Iodide	69.5	482
" "	155.2	943.6	Ammonium Iodide*	94.3	669
Sodium Iodide	13.55	125	Aniline Hydriodide	164	721
" "	57.7	393	Dimethylaniline Hydriodide	160	626
" "	109.1	738	Tetramethylammonium Iodide	49.3	266
" "	228	1251	Tetramethylammonium Iodide	51.4	280
Rubidium Iodide	85.4	421	Strontium Iodide	106.5	599
Rubidium Iodide	217.5	1060	Barium Iodide	42.2	237
Lithium Iodide	84.1	642	Barium Iodide	158.5	809

* Solvent = *o* nitrotoluene instead of nitrobenzene.

Similar results are also given for solutions containing KI in addition to the other iodide, and one series for the simultaneous solubility of KBr and I in nitrobenzene. It is considered that the increased solubility is most easily explained on the assumption that periodides are formed in solution.

SOLUBILITY OF IODINE IN MIXTURES OF SOLVENTS AT 25°.

(Mahieu, 1936.)

In Ether + Chloroform

In Methyl Alcohol + Chloroform

Gms. (C ₂ H ₅) ₂ O per 100 gms. solvent mixture	Gms. I per 100 gms. solvent mixture	Gms. CHCl ₃ per 100 gms. solvent mixture	Gms. I per 100 gms. solvent mixture
0.0 (= CHCl ₃)	2.01	0.0 (= CH ₃ OH)	23.35
25.1	4.80	24.1	17.97
48.1	7.34	50.3	12.75
73.6	15.03	74.4	7.71
100.0	23.86	100.0	2.11

SOLUBILITY OF IODINE IN MIXTURES OF ACETIC ACID AND BENZENE.

(Anders, 1933.)

Results at 0°

Results at 20°

Results at 30°

Gms. CH ₃ COOH per 100 gms. solvent mixture	Gms. I per 100 gms. sat. solution	Gms. CH ₃ COOH per 100 gms. solvent mixture	Gms. I per 100 gms. sat. solution	Gms. CH ₃ COOH per 100 gms. solvent mixture	Gms. I per 100 gms. sat. solvent
21.788	3.892	0.0	8.152	0.0	11.642
47.961	3.156	21.516	7.107	21.371	9.745
58.262	2.224	20.045	6.162	42.681	7.502

SOLUBILITY OF IODINE IN MIXTURES OF CHLOROFORM AND ETHYL ALCOHOL,
CHLOROFORM AND NORMAL PROPYL ALCOHOL, CHLOROFORM AND BENZENE,
AND CHLOROFORM AND CARBON DISULFIDE AT 15°.

(Bruner, 1898.)

Vol. % CHCl ₃ in Solvent.	Gms. I Dissolved per 100 cc. of Mixtures of:			
	CHCl ₃ +C ₂ H ₅ OH.	CHCl ₃ +C ₃ H ₇ OH.	CHCl ₃ +C ₆ H ₆ .	CHCl ₃ +CS ₂ .
0	15.67	14.93	10.40	17.63
10	9.43	13.16	9.84	15.93
20	8.69	11.20	8.78	14.20
30	7.80	8.98	7.74	12.16
40	7.09	8.09	6.96	10.20
50	6.62	7.82	6.20	9.08
60	6.24	7.09	5.34	7.72
70	5.77	6.42	4.89	6.42
80	5.06	5.54	4.53	5.27
90	4.34	4.52	4.07	4.32
100	3.62	3.62	3.62	3.62

SOLUBILITY OF IODINE IN MIXTURES OF CARBON TETRACHLORIDE AND BEN-
ZENE AND IN MIXTURES OF CARBON TETRACHLORIDE AND CARBON DISUL-
FIDE AT 15°.

(Bruner, 1898.)

I Vol. % CCl ₄ in Solvent.	Gms. I per 100 cc. of Mixture of:		Vol. % CCl ₄ in Solvent.	Gms. I per 100 cc. of Mixture of:	
	CCl ₄ +C ₆ H ₆ .	CCl ₄ +CS ₂ .		CCl ₄ +C ₆ H ₆ .	CCl ₄ +CS ₂ .
0	10.40	17.6	60	4.90	5.55
10	9.44	14.44	70	4.09	4.50
20	8.53	12.33	80	3.41	3.37
30	7.77	10.34	90	2.74	2.60
40	6.63	8.60	100	2.06	2.06
50	5.70	6.83			

In the case of the above determinations the volume change occurring on mixing the solvents was neglected. The temperature was not accurately regulated and the mixtures not shaken during the saturation. The curves plotted from the results are not smooth.

SOLUBILITY OF IODINE IN MIXTURES OF CHLOROFORM AND ETHER AT 25°.

(Marden and Dover, 1916.)

Gms. CHCl ₃ per 100 Gms. CHCl ₃ +(C ₂ H ₅) ₂ O.	Gms. Iodine per 100 Gms. CHCl ₃ +(C ₂ H ₅) ₂ O.	Gms. CHCl ₃ per 100 Gms. CHCl ₃ +(C ₂ H ₅) ₂ O.	Gms. Iodine per 100 Gms. CHCl ₃ +(C ₂ H ₅) ₂ O.
0	35.1	60	9.83
10	29.6	70	7.5
20	24.8	80	5.73
30	20.2	90	4.31
40	16.3	100	3.10
50	12.7		

100 cc. of a mixture of CHCl₃ + CS₂ (3:1) dissolve 7.39 gms. iodine (t°?). The addition of S even up to the point of saturation does not affect the amount of iodine held in solution. (Olivari, 1908.)

Diagrammatic results for mixtures of iodine and each of the following compounds are given by Olivari, 1911: CHI₃, *p* C₆H₄Br₂, [C₆H₄]N₂, *p* C₆H₄(NO₂)₂, (C₆H₅CO)₂O and C₆H₅COOH.

SOLUBILITY OF IODINE IN MIXED SOLVENTS AT 16.6°.

(Strömholm, 1903.)

Solvent.	Gms. I per Liter Sat. Sol.	Solvent.	Gms. I per Liter Sat. Sol.
Ether	206.3	Ether+20.96 gms. CS ₂ per liter	202.3
Carbon Disulfide	178.5	Ether+41.9 " CS ₂ "	217.2
Ether+3.96 gms. H ₂ O per liter	221	CS ₂ +22.5 " ether "	189.3
" +7.91 gms. H ₂ O "	235.7	CS ₂ +45.1 " ether "	201.1
" +excess H ₂ O "	251.4	Ether+47.63 " CHCl ₃ "	195.2
" +9.79 gms. C ₂ H ₅ OH "	219.1	CS ₂ +50.06 " CHCl ₃ "	172.8
" +19.6 " " "	231.5	Ether+80.3 " C ₆ H ₆ "	204.1
" +29.4 " " "	243.9	Ether+77.85 " CH ₃ I "	220.2
" +39.2 " " "	254.4	CS ₂ +62.2 " S "	189.4

One liter sat. solution in ether contains 167.3 gms. I at 0°. (Strömholm, 1903.)

SOLUBILITY OF IODINE IN CARBON TETRACHLORIDE CONTAINING OTHER SOLVENTS.

(Groh, 1927.)

Results for Carbon Tetrachloride containing:

Methyl Alcohol			Ethyl Alcohol			Propyl Alcohol		
t°	Gm. Mols. per liter sat. sol. in CCl ₄		t°	Gm. Mols. per liter sat. sol. in CCl ₄		t°	Gm. Mols. per liter sat. sol. in CCl ₄	
	CH ₃ OH	I ₂		C ₂ H ₅ OH	I ₂		C ₃ H ₇ OH	I ₂
0	0.192	0.0524	0	0.205	0.0556	0	0.208	0.0547
"	0.411	0.0601	"	0.410	0.0653	"	0.414	0.0636
"	0.617	0.0673	"	0.609	0.0741	"	0.622	0.0721
"	0.814	0.0743	"	0.808	0.0829	"	0.815	0.0800
"	0.993	0.0806	"	1.025	0.0924	"	1.035	0.0889
"	1.234	0.0891	"	1.232	0.1015	"	1.307	0.1001
"	1.607	0.1022	"	1.621	0.1193	"	1.543	0.1096
"	2.032	0.1168	"	2.013	0.1365	"	2.045	0.1312
11.8	0.188	0.0816	11.7	0.201	0.0849	11.6	0.198	0.0835
"	0.404	0.0920	"	0.404	0.0970	"	0.403	0.0947
"	0.596	0.1006	"	0.596	0.1080	"	0.594	0.1051
"	1.011	0.1191	"	0.807	0.1202	"	0.805	0.1163
"	1.120	0.1237	"	1.010	0.1319	"	1.005	0.1267

Acetic Acid			Ethyl Ether		
t°	Gm. Mols. per liter sat. sol. in CCl ₄		t°	Gm. Mols. per liter sat. sol. in CCl ₄	
	CH ₃ COOH	I ₂		(C ₂ H ₅) ₂ O	I ₂
0	0.0	0.0450	0	0.211	0.0549
"	0.201	0.0464	"	0.422	0.0650
"	0.395	0.0477	"	0.633	0.0748
"	0.797	0.0501	"	0.844	0.0853
"	0.992	0.0513	"	1.055	0.0960
"	1.148	0.0522	"	1.266	0.1063
11.15	0.204	0.0715	11.4	0.0	0.0710
"	0.406	0.0730	"	0.196	0.0815
"	0.547	0.0744	"	0.390	0.0927
"	0.897	0.0765	"	0.585	0.1037
"	1.181	0.0786	"	0.865	0.1206
			"	1.171	0.1399

MUTUAL SOLUBILITY OF LIQUID IODINE AND CARBON TETRACHLORIDE.
(Hildebrand, 1937.)

The determinations were made by the synthetic method but due to the opacity of concentrate iodine solutions advantage was taken of the difference in density of the two liquid phases for detecting their points of separation.

t°	Wt % Iodine	Mol % Iodine	t°	Wt % Iodine	Mol % Iodine
128.8	44.8	33.0	160.5 (max.)	—	67.0
155.0	63.0	50.8	160.1	80.8	71.8
158.1	67.0	55.1	159.9	81.7	73.1
160.6	76.0	65.7	153.5	86.6	79.7

SOLUBILITY OF IODINE IN ARSENIC TRICHLORIDE. (Sloan and Mallet, 1882.)

t°.	o°.	15°.	96°.
Gms. I per 100 gms. AsCl ₃	8.42	11.88	36.89

FREEZING-POINTS OF MIXTURES OF IODINE AND IODOFORM.
(Vasilev, 1916.)

I	I content of mixture.			t°.	I content of mixture.			Solid Phase.
	t°.	Wt. % I ₂ .	Atom % I ₂ .		t°.	Wt. % I ₂ .	Atom % I ₂ .	
	114.0....	100.0	100.0	I	66.1 (Eutec.)	42.3	—	I+CHI ₃
	97.8 ...	87.84	95.70	»	70.9.....	38.85	66.33	CHI ₃
	94.8....	85.38	94.82	»	78.1.....	31.45	58.76	»
	79.8....	70.22	87.98	»	86.2.....	24.63	50.35	»
	73.6....	59.41	81.96	»	95.8.....	17.63	39.40	»
	71.2....	53.30	77.96	»	111.9.....	5.20	14.55	»
	69.5....	49.08	74.94	»	119.7.....	0.0	0.0	»

Similar data for iodine + naphthalene gave a single eutectic at 65° and 39.43 wt. % I.

Fusion-point data are given for the following mixtures:

- I + As (Jaeger and Doornbosch, 1912.)
- I + CaI₂ (Olivari, 1908.)
- I + HgI₂ " "
- I + In (Thiel and Koelsch, 1910.)
- I + KI (Olivari, 1914; Briggs and Geigle, 1930; Fialkow and Kensmenko, 1936.)
- I + LiI (Fialkow and Kensmenko, 1936.)
- I + S (Olivari, 1908; Boulouch, 1903; Smith and Carson, 1908.)
- I + Sb (Jaeger and Doornbosch, 1912.)
- I + Se (Pellini and Pedrina, 1908.)
- I + Sn (Van Klooster, 1912-13; Reinders and Lange, 1912-13; Vasilev, 1916, 1917.)
- I + Te (Jaeger and Menke, 1912; Damiens, 1921, 1923.)
- I + Tl (Fialkow and Kensmenko, 1936.)
- I + Each of the following compounds: Azobenzene, benzoic acid, Benzoic anhydride, Dibrom benzene, *p*-Dinitrobenzene, Iodoform, Tetra methyl ammonium Iodide and Tri methyl phenyl ammonium iodide. (Olivari, 1911.)

IODINE CYANIDE ICN

One liter sat. solution of iodine cyanide in water contains 0.2523 gm. mols. at 25°. (Yost and Stone, 1933.)

DISTRIBUTION OF IODINE CYANIDE BETWEEN WATER
AND CARBON TETRACHLORIDE AT 25°
(Yost and Stone, 1933.)

Gm. Mols. ICN per liter of:		$\frac{c}{w}$
H ₂ O layer (w)	CCl ₄ layer (c)	
0.02480	0.004460	0.1798
0.03312	0.006007	0.1814
0.05144	0.009441	0.1835
0.06697	0.01239	0.1850
0.07960	0.01482	0.1862

CN

IODINE PENTOXIDE I₂O₅.

SOLUBILITY OF IODINE PENTOXIDE IN SULFURIC ACID AT 24°.77.
(Lamb and Phillips, 1923.)

Constant rotation in a thermostat was employed. Equilibrium was reached in some cases within one day, but with higher concentrations of sulfuric acid, there was a slow decrease from a definite initial solubility. This was studied over a period of 55 days and constancy was reached in all cases within 40 days.

Per cent conc. of H ₂ SO ₄	Gms I ₂ O ₅ per liter		Per cent conc. of H ₂ SO ₄	Gms I ₂ O ₅ per liter	
	Initial.	Final.		Initial.	Final.
50.0.....	54.79	54.79	89.0.....	22.1	15.1
60.0.....	34.68	34.68	90.3.....	22.7	14.5
75.0.....	19.48	19.48	92.0.....	23.4	13.5
78.0.....	18.66	18.66	96.0.....	(23.2)	11.0
79.6.....	19.0	18.5	98.0.....	(22.0)	9.5
82.0.....	19.9	18.8	99.9.....	—	3.48
84.6.....	20.5	19.3	102.0.....	—	1.28
86.0.....	21.0	17.1	104.0.....	—	1.90
87.4.....	21.5	15.8	106.0.....	—	2.67

* This percentage represents weights of 100 % H₂SO₄ equivalent to 100 gm. of the acid in question. The 106.5 % of acid, therefore, contained 29.0 % of free SO₃.

INDIUM In

SOLUBILITY OF INDIUM IN MERCURY.

(Parks and Moran, 1937.)

°C	Gms. In per 100 gms. In + Hg	Gm. Atoms In per 100 gms. Atoms In + Hg
0	1.23	2.14
12.5	1.27	2.20
25	1.26	2.18
37.5	1.28	2.22
50	1.31	2.27

INDIUM IODATE In(IO₃)₃.

100 gms. H₂O dissolve 0.067 gm. In(IO₃)₃ at 20°. (Mathers and Schluederberg, 1908.)

Ir Iridium

680

IRIDIUM Ammonium SULFATE $\text{Ir}_2(\text{NH}_4)_2(\text{SO}_4)_4 \cdot 24\text{H}_2\text{O}$

100 gms. H_2O dissolve 200 gms. of the salt at 16° and 400 gms. at 30° . (Rossler, 1873.)

IRIDIUM CHLORIDE IrCl_4 .

When 1 gm. iridium as chloride is dissolved in 100 cc. of 10% HCl and shaken at 18° with 100 cc. of ether, 0.02 per cent of the metal enters the ethereal layer. When 20% HCl is used 5% of the metal enters the ether. When dissolved in 1% HCl or in water approximately 0.01 per cent of the metal enters the ethereal layer. (Mylius, 1911.)

IRIDIUM Potassium CHLORIDE IrK_2Cl_6

100 gms. H_2O dissolve 1.25 gms. IrK_2Cl_6 at $18-20^\circ$.

100 gms. H_2O dissolve 9.18 gms. dipotassium aquo penta chloroiridite, $\text{IrCl}_6(\text{H}_2\text{O})\text{K}_2$ at 19° . (Delepine, 1908.)

IRIDIUM Ammonium CHLORIDE $\text{IrCl}_4 \cdot 2\text{NH}_4\text{Cl}$.

SOLUBILITY IN WATER.
(Rimbach and Korten, 1907.)

t°.	Gms. $\text{IrCl}_4 \cdot 2\text{NH}_4\text{Cl}$ per 100 Gms.		t°.	Gms. $\text{IrCl}_4 \cdot 2\text{NH}_4\text{Cl}$ per 100 Gms.	
	Water.	Sat. Sol.		Water.	Sat. Sol.
14.4	0.699	0.694	52.2	1.608	1.583
26.8	0.905	0.899	61.2	2.130	2.068
39.4	1.226	1.124	69.3	2.824	2.746

AMMONIUM Iridium CHLORIDE $(\text{NH}_4)_2\text{IrCl}_6$.

SOLUBILITY IN WATER. (Archibald and Kern, 1917.)

t°.	Gms. $(\text{NH}_4)_2\text{IrCl}_6$ per 100 gms. H_2O .	t°.	Gms. $(\text{NH}_4)_2\text{IrCl}_6$ per 100 gms. H_2O .
0.2.....	0.5561	40.0.....	1.5665
10.0.....	0.7055	50.0.....	1.9664
25.0.....	1.0910	60.0.....	2.4567
30.0.....	1.2066	80.0.....	4.3815

Decomposition occurs at higher temperatures.

SOLUBILITY IN AQUEOUS SOLUTIONS OF AMMONIUM CHLORIDE AT 20° .

(Archibald and Kern, 1917.)

Gm. mols. NH_4Cl per liter.	Gms. $(\text{NH}_4)_2\text{IrCl}_6$ per 100 gms. solvent.	Gm. mols. NH_4Cl per liter.	Gms. $(\text{NH}_4)_2\text{IrCl}_6$ per 100 gms. solvent.
0.10	0.1793	1.00	0.0064
0.20	0.0780	2.00	0.0027

IRIDIUM Ammonium CHLORIDE $\text{Ir}(\text{NH}_4)_2\text{Cl}_6$

SOLUBILITY OF IRIDIUM AMMONIUM CHLORIDE IN AQUEOUS
SOLUTIONS OF PLATINUM AMMONIUM CHLORIDE AND VICE VERSA AT 18° .
(Ogawa, 1930.)

Gms. per 100 gms. sat. solution		Gms. per 100 gms. sat. solution	
$\text{Ir}(\text{NH}_4)_2\text{Cl}_6$	$\text{Pt}(\text{NH}_4)_2\text{Cl}_6$	$\text{Ir}(\text{NH}_4)_2\text{Cl}_6$	$\text{Pt}(\text{NH}_4)_2\text{Cl}_6$
1.086	0.0	0.424	0.364
1.016	0.089	0.258	0.481
0.902	0.196	0.197	0.594
0.605	0.267	0.105	0.605
0.524	0.288	0.0	0.768

SOLUBILITY OF IRIDIUM AMMONIUM CHLORIDES IN WATER AT 19°.
(Telepine, 1908.)

Name of Salt.	Formula.	Gms. per 100 Gms. H ₂ O.
Ammonium iridium chloride	(NH ₄) ₂ IrCl ₆	0.77
Diammonium aquo penta chloro iridite	IrCl ₅ (H ₂ O)(NH ₄) ₂	15.4
Triammonium hexa chloro iridite	IrCl ₆ (NH ₄) ₃ +H ₂ O	10.5

IRIDIUM Sodium CHLORIDE IrNa₂Cl₆·12H₂O

SOLUBILITY OF IRIDIUM SODIUM CHLORIDE IN WATER.
(Ogawa, 1930.)

t°	Gms. IrNa ₂ Cl ₆ per 100 gms. H ₂ O	t°	Gms. IrNa ₂ Cl ₆ per 100 gms. H ₂ O	t°	Gms. IrNa ₂ Cl ₆ per 100 gms. H ₂ O
15	34.46	40	96.00	63	202.63
22	41.39	45	123.96	70	231.66
25	46.11	51	155.26	75	253.17
30	56.17	55	169.27	80	279.34
35	74.03	60	191.18	85	307.26

IRIDIUM DOUBLE SALTS.

SOLUBILITY IN WATER.
(Palmaer — Ber. 23, 3817; 24, 2090, '91.)

Double Salt.	Formula.	t°.	Gms. per 100 Gms. H ₂ O.
Irido Pentamine Bromide	Ir(NH ₃) ₅ Br ₃	12.5	0.284
" " Bromonitrate	Ir(NH ₃) ₅ Br(NO ₃) ₂	18	5.58
" " Tri Chloride	Ir(NH ₃) ₅ Cl ₃	15.1	6.53
" " Chloro Bromide	Ir(NH ₃) ₅ ClBr ₂	15	0.47
" " Chloro Iodide	Ir(NH ₃) ₅ ClI ₂	15	0.95
" " Chloro Nitrate	Ir(NH ₃) ₅ Cl(NO ₃) ₂	15.4	1.94
" " Chloro Sulphate	Ir(NH ₃) ₅ ClSO ₄ ·2H ₂ O	15.0	0.74
" " Nitrate	Ir(NH ₃) ₅ (NO ₃) ₃	16	0.28
" Aquo Pentamine Bromide	Ir(NH ₃) ₅ (OH ₂)Br ₃	ord. temp.	25.0
" " " Chloride	Ir(NH ₃) ₅ (OH ₂)Cl ₃	ord. temp.	74.7
" " " Nitrate	Ir(NH ₃) ₅ (OH ₂)(NO ₃) ₃	17	10.0

Cl

SOLUBILITY OF EACH IN WATER AT 20° (Benrath, 1924.)

Compound.	Formula.	Gms. empd. per 100 cc. H ₂ O.	Gms. mois. empd. per liter sat. sol.
Mono quinine hexa chlor iridate...	C ₂₀ H ₂₁ N ₃ O ₂ ·H ₂ IrCl ₆	0.0439	6.0·10 ⁻⁴
" " " brom " ...	C ₂₀ H ₂₁ N ₃ O ₂ ·H ₂ IrBr ₆	0.0174	1.7·10 ⁻⁴
Di quinine " chlor " ...	(C ₂₀ H ₂₁ N ₃ O ₂) ₂ ·H ₂ IrCl ₆	0.0012	1.2·10 ⁻⁵
Mono cinchonine " " " ...	C ₁₉ H ₂₁ N ₃ O·H ₂ IrCl ₆	0.1263	1.8·10 ⁻³
" " " brom " ...	C ₁₉ H ₂₁ N ₃ O·H ₂ IrBr ₆	0.0062	6.5·10 ⁻⁵
Di cinchonine " chlor " ...	(C ₁₉ H ₂₁ N ₃ O) ₂ ·H ₂ IrCl ₆	0.0037	3.5·10 ⁻⁵
Mono cinchonidine " " " ...	C ₁₉ H ₂₁ N ₃ O·H ₂ IrCl ₆	0.0277	3.9·10 ⁻⁴
" " " brom " ...	C ₁₉ H ₂₁ N ₃ O·H ₂ IrBr ₆	0.0048	5.0·10 ⁻⁵
Di cinchonidine " chlor " ...	(C ₁₉ H ₂₁ N ₃ O) ₂ ·H ₂ IrCl ₆	0.0034	3.4·10 ⁻⁵
Strychnine " " " ...	(C ₂₁ H ₂₂ N ₂ O ₂) ₂ ·H ₂ IrCl ₆	0.0045	4.3·10 ⁻⁵
" " " brom " ...	(C ₂₁ H ₂₂ N ₂ O ₂) ₂ ·H ₂ IrBr ₆	0.0015	1.2·10 ⁻⁵
Brucine " chlor " ...	(C ₂₃ H ₂₆ N ₂ O ₄) ₂ ·H ₂ IrCl ₆	0.0083	7.0·10 ⁻⁵
" " " brom " ...	(C ₂₃ H ₂₆ N ₂ O ₄) ₂ ·H ₂ IrBr ₆	0.0015	1.2·10 ⁻⁵
Nitron " chlor " ...	(C ₂₀ H ₁₆ N ₄) ₂ ·H ₂ IrCl ₆	0.0082	8.0·10 ⁻⁵
" " " brom " ...	(C ₂₀ H ₁₆ N ₄) ₂ ·H ₂ IrBr ₆	0.0086	1.2·10 ⁻⁵

IRIDIUM OXIDE $\text{IrO}_2 \cdot x\text{H}_2\text{O}$

One liter of water sat. with Iridium Oxide contains 0.002 gm. IrO_2 at 20°.

One liter of 0.002 N HCl sat. with Iridium Oxide contains 0.0005 gm. IO_2 at 20°. (Moser and Hachhofer, 1932.)

POTASSIUM K_2

SOLUBILITY OF POTASSIUM IN LIQUID AMMONIA.

Results of Ruff and Geisel, 1906

Results of Johnston and Meyer, 1929

t°	Mols. NH_3 to dissolve 1 gm. atom K	t°	Gms. K dissolved per 100 gms. NH_3
-100	4.82	-50.38	45.56
-50	4.79	-33.5	46.38
0	4.74	0	49.05

SOLUBILITY OF POTASSIUM IN MELTED KOH. (von Hevesy, 1909.)

Difficulty was experienced due to the failure of the excess of K to separate completely from the saturated solution. Time of heating, 50 hours.

t°.	Gms. K per 100 Gms. KOH.
480	7.8-8.9
600	3-4
650	2-2.7
700	0.5-1.3

Fusion-point data for mixtures of Potassium and Rubidium are given by Gorla, 1935.)

A10

POTASSIUM ALUMINATE $\text{K}_2\text{O} \cdot \text{Al}_2\text{O}_3 \cdot 3\text{H}_2\text{O}$.EQUILIBRIUM IN THE SYSTEM POTASSIUM HYDROXIDE,
ALUMINUM HYDROXIDE AND WATER AT 30°.

(Jucaltis, 1934.)

The mixtures were shaken for 3 months.

Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase
K_2O	Al_2O_3		K_2O	Al_2O_3	
30.21	15.58	$\text{K}_2\text{O} \cdot \text{Al}_2\text{O}_3 \cdot 3\text{H}_2\text{O}$	39.40	3.01	$\text{K}_2\text{O} \cdot \text{Al}_2\text{O}_3 \cdot 3\text{H}_2\text{O}$
30.87	12.51	"	41.25	2.20	"
31.65	10.90	"	43.86	1.73	"
32.03	9.79	"	44.74	1.26	"
32.40	8.62	"	45.41	1.80	"
35.67	4.68	"	46.06	1.25	"
38.38	3.93	"	47.83	0.92	"

POTASSIUM (Dihydrogen) ARSENATE KH_2AsO_4 .

100 gms. sat. aq. solution contain 15.9 gms. KH_2AsO_4 , or 100 gms. H_2O dissolve 18.86 gms. at 6°. Sp. Gr. of solution = 1.1134. (Field, 1859.)

100 cc. sat. aq. solution contain 28.24 gms. KH_2AsO_4 at about 7°.

(Muthmann and Kuntze, 1894.)

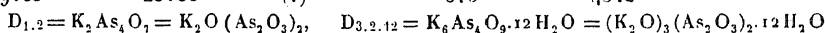
100 gms. glycerol ($d_{15} = 1.256$) dissolve 50.1 gms. potassium arsenate at 15-16°.

(Ossendowski, 1907.)

POTASSIUM ARSENITES $K_2As_4O_7$, $K_6As_4O_9 \cdot 12H_2O$.EQUILIBRIUM IN THE SYSTEM POTASSIUM OXIDE, ARSENIC TRIOXIDE AND WATER
AT 25°. (Schreinemakers and De Baat, 1920.)

For saturation 4 to 6 weeks agitation at 25° was employed.

Gms. per 100 gms. sat. sol.		Solid Phase.	Gms. per 100 gms. sat. sol.		Solid Phase.
As_2O_3	K_2O		As_2O_3	K_2O	
2.02	0.0	As_2O_3	48.96	24.16	$D_{3.2.12}$
22.63	5.61	"	44.84	23.61	"
36.29	8.79	"	39.49	23.49	"
41.93	9.69	"	33.60	24.07	"
54.02	11.62	"	24.16	28.05	"
58.11	13.74	$D_{1.2}$	20.98	32.93	"
53.49	15.24	"	22.47	35.96	"
49.58	17.28	"	29.61	38.32	"
49.21	18.61	"	23.82	42.48	$KOH \cdot H_2O$
49.02	20.19	"	17.57	43.52	"
49.47	22.01	(?)	11.53	44.13	$KOH \cdot 2H_2O$
49.65	23.00	(?)	0.0	45.5	"

**POTASSIUM BORATES.**

SOLUBILITY OF POTASSIUM BORATES IN WATER AT 30°.

(Dukelski — Z. anorg. Chem. 50, 42, '06, complete references given.)

Gms. per 100 Gms. Solution.		Gms. per 100 Gms. Residue.		Solid Phase.	
K_2O	B_2O_3	K_2O	B_2O_3		
47.50	...	...	...	$KOH \cdot 2H_2O$	
46.36	0.91	46.13	9.02	$K_2O \cdot B_2O_3 \cdot 2\frac{1}{2}H_2O$	BO
40.51	1.25	41.62	9.71	"	
36.82	1.80	39.90	13.19	"	
32.74	3.51	37.22	14.58	"	
29.63	6.98	35.05	17.92	"	
24.84	17.63	30.02	21.70	"	
23.30	18.19	26.84	31.49	$K_2O \cdot 2B_2O_3 \cdot 4H_2O$	
16.21	13.10	25.12	33.18	"	
11.78	9.82	20.57	26.43	"	
9.18	8.00	22.38	31.30	"	
6.22	9.13	20.87	31.06	"	
7.73	13.37	22.21	36.24	$K_2O \cdot 2B_2O_3 \cdot 4H_2O + K_2O \cdot 5B_2O_3 \cdot 8H_2O$	
7.81	13.28	17.50	34.18		
7.71	13.21	11.49	34.81	$K_2O \cdot 5B_2O_3 \cdot 8H_2O$	
7.63	13.28	12.51	40.52	"	
3.42	7.59	10.77	37.35	"	
1.80	4.15	5.88	20.00	"	
0.51	3.19	10.81	40.89	"	
0.33	4.58	7.72	34.21	$K_2O \cdot 5B_2O_3 \cdot 8H_2O + B(OH)_3$	
0.31	4.46	3.91	30.68	"	
...	3.54	...	...	"

POTASSIUM MetaBORATE $KB(O_2)$.

Fusion-point data for potassium metaborate + sodium metaborate and for potassium metaborate + potassium metaphosphate are given by van Klooster (1910-11).

POTASSIUM PerBORATES, $2\text{KBO}_3 \cdot \text{H}_2\text{O}$, $2\text{KBO}_3 \cdot \text{H}_2\text{O}_2$.**SOLUBILITY OF EACH IN WATER.**

(v. Girssewald and Wolokitin, 1909.)

Borate.	% Active O in Borate.	t°.	Gms. Salt per 100 Gms. Water.
$2\text{KBO}_3 \cdot \text{H}_2\text{O}$	14.93	0	1.25
"	14.93	15	2.50
$2\text{KBO}_3 \cdot \text{H}_2\text{O}_2$	20.84	15	0.70

POTASSIUM Di BORATE $\text{K}_2\text{O} \cdot 2\text{B}_2\text{O}_3 \cdot 5$ or $6 \text{H}_2\text{O}$

1000cc sat. solution of Potassium Diborate in Water has a normality of 0.9 with respect to K at 0°. A similar solution saturated with potassium pentaborate has a normality of 0.07 with respect to K. (Rosenheim and Leyser, 1921.)

POTASSIUM Penta BORATE $\text{K}_2\text{O} \cdot 5\text{B}_2\text{O}_3 \cdot 8\text{H}_2\text{O}$ **SOLUBILITY OF POTASSIUM PENTA BORATE IN WATER.**

(Rollet and Andres, 1930.)

The pentaborate was prepared by the action of boric acid upon potassium chloride and upon potassium nitrate at temperatures above 100° in presence of water vapor. The anhydrous salt hydrates easily in moist air.

BO

t°	(Gms. $\text{K}_2\text{O} \cdot 5\text{B}_2\text{O}_3$) per 100 gms. sat. sol.	Solid Phase	t°	(Gms. $\text{K}_2\text{O} \cdot 5\text{B}_2\text{O}_3$) per 100 gms. sat. sol.	Solid Phase
-0.53 (Eutec)	1.54 (1.50)	$\text{Ice} + \text{K}_2\text{O} \cdot 5\text{B}_2\text{O}_3 \cdot 8\text{H}_2\text{O}$	75	13.22	$\text{K}_2\text{O} \cdot 5\text{B}_2\text{O}_3 \cdot 8\text{H}_2\text{O}$
0	1.56	$\text{K}_2\text{O} \cdot 5\text{B}_2\text{O}_3 \cdot 8\text{H}_2\text{O}$	76.65	13.62	"
5	1.77	"	82.3	15.5	"
18	2.66 (2.75)	"	87.15	17.02	"
25	— (3.41)	"	89.8	18.00	"
30	3.8	"	94.8	19.85	"
45	5.72	"	100	22.3	"
57.6	8.45	"	101.65	23.0	"
62.8	9.85	"	102.3 (b.pt.)	23.4	"
69.0	11.5	"			

The authors also found that at about 170° the solid phase is transformed to $\text{K}_2\text{O} \cdot 5\text{B}_2\text{O}_3 \cdot 2\text{H}_2\text{O}$ and above 350° it becomes the anhydrous compound—which melts at 780°.

The values in parentheses in the above table are by Menzel, 1927.)

EQUILIBRIUM IN THE SYSTEM POTASSIUM TETRABORATE, POTASSIUM PENTABORATE POTASSIUM CHLORIDE AND WATER AT 35°.

(Teepie, 1929.)

Gms. per 100 gms. H_2O			Solid Phase
KCl	$\text{K}_2\text{B}_4\text{O}_7$	$\text{K}_2\text{B}_5\text{O}_{16}$	
39.0	—	—	KCl
—	21.3	—	$\text{K}_2\text{B}_4\text{O}_7 \cdot 4\text{H}_2\text{O}$
—	—	5.0	$\text{K}_2\text{B}_{10}\text{O}_{16} \cdot 8\text{H}_2\text{O}$
37.3	5.9	—	$\text{KCl} + \text{K}_2\text{B}_4\text{O}_7 \cdot 4\text{H}_2\text{O}$
38.1	—	3.0	$\text{KCl} + \text{K}_2\text{B}_{10}\text{O}_{16} \cdot 8\text{H}_2\text{O}$
—	23.8	8.0	$\text{K}_2\text{B}_4\text{O}_7 \cdot 4\text{H}_2\text{O} + \text{K}_2\text{B}_{10}\text{O}_{16} \cdot 8\text{H}_2\text{O}$
36.8	6.7	3.5	$\text{KCl} + "$

POTASSIUM Fluob BORATE KF_4B

One liter of water sat. with Potassium fluoborate at room temperature (20°) contains 0.045 gm. mols. KF_4B . (deBoer and van Liempt, 1927.)
 100 gms. H_2O dissolve 0.44 gm. KF_4B at 20° and 6.27 gms. at 100° . (Stolha, 1889.)

EQUILIBRIUM IN THE SYSTEM POTASSIUM FLUOBORATE,
POTASSIUM PERCHLORATE AND WATER AT 25° .

(Ray and Mitra, 1934.)

Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase
KF_4B	KClO_4		KF_4B	KClO_4	
0.574	0.0	KF_4B	0.420	0.814	$8\text{KF}_4\text{B} \cdot \text{KClO}_4$
0.562	0.213	"	0.427	0.943	"
0.569	0.276	"	0.437	1.012	" + $2\text{KF}_4\text{B} \cdot \text{KClO}_4$
0.589	0.328	"	0.406	1.077	$2\text{KF}_4\text{B} \cdot \text{KClO}_4$
0.588	0.393	" + $8\text{KF}_4\text{B} \cdot \text{KClO}_4$	0.385	1.165	"
0.558	0.432	$8\text{KF}_4\text{B} \cdot \text{KClO}_4$	0.337	1.433	"
0.476	0.549	"	0.243	1.616	KClO_4
0.433	0.684	"	0.0	1.971	"

BF

EQUILIBRIUM IN THE SYSTEM POTASSIUM FLUOBORATE
POTASSIUM PERIODATE AND WATER AT 35° .

(Ray and Mitra, 1935.)

The results are given only in the form of a triangular diagram from which the following approximate values were read.

Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase
KF_4B	KIO_4		KF_4B	KIO_4	
0.92	0.0	KF_4B	0.60	0.48	KIO_4
0.91	0.2	"	0.40	0.55	"
0.90	0.4	" + KIO_4	0.20	0.68	"
0.80	0.42	KIO_4	0.0	0.80	"

EQUILIBRIUM IN THE SYSTEM POTASSIUM FLUOBORATE
POTASSIUM PERMANGANATE AND WATER AT 25° .

(Ray and Chatterji, 1932.)

Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase
KF_4B	KMnO_4		KF_4B	KMnO_4	
0.57	0.0	KF_4B	0.48	4.78	$\text{KF}_4\text{B} \cdot 6\text{KMnO}_4$
0.54	1.12	"	0.37	5.42	"
0.46	1.58	"	0.22	6.03	" + KMnO_4
0.22	2.07	" + $\text{KF}_4\text{B} \cdot 6\text{KMnO}_4$	0.33	6.32	KMnO_4
0.41	3.19	$\text{KF}_4\text{B} \cdot 6\text{KMnO}_4$	0.28	6.76	"
0.50	4.08	"	0.0	6.90	"

POTASSIUM BROMIDE KBr .

FREEZING-POINTS OF AQUEOUS SOLUTIONS OF POTASSIUM BROMIDE.

(Klein and Svanberg, 1920; Rodebush, 1918.)

t°	Gms. KBr per 100 cc. sat. sol.	t°	Gms. KBr per 100 gms. H_2O .	t°	Gms. KBr per 100 gms. H_2O .
-0.348....	1.19 (K and S)	-3.19....	11.53	-10.55....	38.33
-0.863....	2.975 "	-5.61....	20.42	-10.90....	39.50
-1.694....	5.95 "	-6.57....	23.82	-12.6Eutec...	45.65
		-8.51....	30.87		

Br

POTASSIUM BROMIDE KBr.

SOLUBILITY IN WATER.

(Average curve from results of Meusser — Z. anorg. Chem. 44, 79, '05; Etard — Compt. rend. 98, 1432, '84; Ann. chim. phys. [7] 2, 526, '94; de Coppet — *Ibid.* [5] 30, 416, '83; Tilden and Shenstone — Phil. Trans. 175, 23, '84.)

t°.	Grams KBr per 100 Grams		t°.	Grams KBr per 100 Grams	
	Solution.	Water.		Solution.	Water.
— 6.5	20.0	25.0	30	41.4	70.6
— 8.5	26.5	35.7	40	43.0	75.5
— 10.5	29.5	41.8	50	44.5	80.2
— 11.5	31.2	45.3	60	46.1	85.5
— 10	31.8	46.7	70	47.4	90.0
— 5	33.3	50.0	80	48.7	95.0
0	34.9	53.5	90	49.8	99.2
5	36.1	56.5	100	51.0	104.0
10	37.3	59.5	110	52.3	109.5
15	38.5	62.5	140	54.7	120.9
20	39.5	65.2	181	59.3	145.6
25	40.4	67.7			

More recent very careful determinations of the Solubility of Potassium Bromide in Water are as follows:

Br

t°	d of sat. sol.	Gms. KBr per 100 gms. sat. sol.	t°	d of sat. sol.	Gms. KBr per 100 gms. sat. sol.
— 12.5 (Eutec.) —		31.27 (1)	35	1.3941	42.58 (3)
0	1.3237	35.08 (3)	50	—	44.85 (1)
+15	1.3597	38.59 (3)	50.21	1.4160	44.95 (3)
20	1.3701	39.73 (2)	75	—	48.3 (1)
25	1.3790	40.65 (1)	91.95	1.4590	50.36 (3)
25	1.3794	40.71 (2)	100	1.465	51.2 (1)
25	1.3794	40.57 (4)	100	—	51.29 (5)

(1) Hering, 1936; (2) Flottmann, 1928; (3) Scott and Durham, 1930; (4) Scott and Frazier, 1927; (5) Brönsted, 1913.

The following values for the solubility of Potassium Bromide in water at temperatures above 100°, determined by the synthetic method, are given by Benrath, Gjedebo, Schiffers and Wunderlich, 1937.

t°	Gms. KBr per 100 gms. sat. sol.	t°	Gms. KBr per 100 gms. sat. sol.	t°	Gms. KBr per 100 gms. sat. sol.
103	51.5	232	63.1	301	67.7
167	57.5	251	65.2	359	70.7
208	61.1	275	66.7	421	73.3

SOLUBILITY OF MIXTURES OF POTASSIUM BROMIDE AND SILVER BROMIDE IN WATER.

(Lambert, 1926.)

The mixtures were constantly stirred in a thermostat.

t°.	Gms. per 100 gms. sat. sol.		Solid Phase.	t°.	Gms. per 100 gms. sat. sol.		Solid Phase.
	Ag Br.	K Br.			Ag Br.	K Br.	
— 13....	1.67	39.87	Ag Br + K Br	70....	5.80	45.48	Ag Br + K Br
+ 30....	1.636	39.54	»	70....	5.60	45.53	»
40....	2.24	40.88	»	80....	6.72	46.91	»
50....	3.25	43.09	»	90....	8.47	48.15	»
50....	3.12	42.43	»	90....	9.00	47.98	»
60....	4.20	44.24		100....	10.55	48.66	»

SOLUBILITY OF POTASSIUM BROMIDE IN BROMINE WATER AT 32°.4
(Joseph, 1920.)

The mixtures were constantly agitated in a thermostat for 24 hours.

<i>d</i> of sat. sol.	Gms. per 100 gms. H ₂ O		<i>d</i> of sat. sol.	Gms. per 100 gms. H ₂ O	
	Br.	KBr.		Br.	KBr.
1.3917	0.0	72.56	1.4753	13.72	77.11
1.4063	2.40	73.39	1.5236	22.97	80.13
1.4070	3.21	73.82	1.5980	38.21	84.59
1.4132	3.96	74.07	2.596	430.4	210.4*
1.4356	7.43	75.02	2.860	1472.0	279.6*
1.4633	12.09	76.43			

* In these two cases the mixtures were simply left in bottles for some days at about 28°, and the heavy dark liquid filtered through glass wool and analyzed. The densities were taken by means of a Westphal balance.

SOLUBILITY OF POTASSIUM BROMIDE IN AQUEOUS SOLUTIONS
OF HYDROBROMIC ACID AT 25°.

(Scott and Durham, 1930.)

Gms. per 100 gms. sat. solution	
HBr	KBr
0.0	40.62
6.88	30.99
13.23	22.69
18.07	17.60

Br

SOLUBILITY OF POTASSIUM BROMIDE IN AQUEOUS SOLUTIONS OF
POTASSIUM BROMATE AND VICE VERSA.

(Guerassimow, 1934.)

Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase
KBr	KBrO ₃		KBr	KBrO ₃		KBr	KBrO ₃	
Results at 0°			Results at 40° (con.)			Results at 60° (con.)		
35.30	0.0	KBr	42.44	1.28	KBr	10.07	12.74	KBrO ₃
35.08	0.57	"	42.34	2.19	" + KBrO ₃	9.52	12.83	"
35.16	0.65	" + KBrO ₃	35.97	2.60	KBrO ₃	9.37	13.14	"
0.0	2.96	KBrO ₃	20.84	4.32	"	4.48	14.92	"
			8.50	7.32	"	4.35	15.58	"
Results at 20°			0.0	11.70	"	3.94	16.43	"
39.4	0.0	KBr				0.0	18.21	"
39.26	1.22	" + KBrO ₃	Results at 60°			Results at 80°		
22.20	1.85	KBrO ₃						
11.80	2.73	"	46.2	0.0	KBr			
0.0	6.43	"	45.17	3.70	" + KBrO ₃	49.72	0.0	KBr
			49.93	3.75	KBrO ₃	46.5	5.62	" + KBrO ₃
Results at 40°			44.56	3.73	"	45.57	5.60	KBrO ₃
43.54	0.0	KBr	31.90	5.71	"	7.45	20.74	"
42.97	0.34	"	12.69	12.09	"	0.0	25.53	"

SOLUBILITY OF POTASSIUM BROMIDE IN AQUEOUS SOLUTIONS
OF POTASSIUM BROMATE AND VICE VERSA AT 25°.
(Ricci, 1934.)

d of sat. sol.	Gms. per 100 gms. sat. sol.		Solid Phase
	KBr	KBrO ₃	
1.381	40.62	0.0	KBr
1.389	40.08	1.20	"
1.392	40.00	1.43	" + KBrO ₃
1.328	34.82	1.62	KBrO ₃
1.237	26.05	2.06	"
1.161	17.48	2.73	"
1.089	7.82	4.29	"
1.054	0.0	7.533	"

SOLUBILITY OF POTASSIUM BROMIDE IN AQUEOUS SOLUTIONS OF
POTASSIUM CHLORIDE, AND OF POTASSIUM CHLORIDE IN AQUEOUS
SOLUTIONS OF POTASSIUM BROMIDE, AT 25.2°.
(Touren — Compt. rend. 130, 1252, '00.)

Br	KBr in Aq. KCl Solutions.				KCl in Aq. KBr Solutions.			
	Mols. per Liter.		Grams per Liter.		Mols. per Liter.		Grams per Liter.	
	KCl.	KBr.	KCl.	KBr.	KBr.	KCl.	KBr.	KCl.
0.0	4.761	0.0	567.0	0.0	4.18	0.00	311.8	
0.67	4.22	50.0	502.5	0.49	3.85	58.4	287.2	
0.81	4.15	60.4	494.2	0.85	3.58	101.3	267.1	
1.35	3.70	100.7	440.7	1.31	3.19	156.1	238.0	
1.48	3.54	110.4	421.6	1.78	2.91	211.9	217.1	
1.61	3.42	120.0	407.2	2.25	2.58	268.0	192.4	
1.70	3.34	126.8	397.7	2.69	2.33	320.4	173.8	
2.46	2.50	183.5	297.7					
3.775	0.525	281.6	625.3					

SOLUBILITY OF POTASSIUM BROMIDE IN AQUEOUS SOLUTION OF POTASSIUM
CHLORIDE AND VICE VERSA AT 25°.

(Fock, 1897.)

Grams per Liter Solution.		Milligram Mols. per Liter.		Mol. per cent KCl in Solution.	Sp. Gr. of Solutions.	Mol. per cent KCl in Solid Phase.
KBr.	KCl.	KBr.	KCl.			
558.1	0.00	4686.2	0.0	0.0	1.3756	0.00
531.5	23.44	4462.7	314.2	6.16	1.3700	0.00
503.6	46.57	4228.5	624.3	12.86	1.3648	8.23
454.6	82.62	3817.8	1108.0	22.49	1.3544	15.68
379.6	136.6	3188.1	1830.7	36.48	1.3320	33.66
324.8	166.9	2727.6	2237.4	45.06	1.3119	63.51
218.0	213.9	1830.2	2868.0	60.30	1.2689	82.29
140.7	250.9	1181.1	3363.9	74.01	1.2455	88.04
47.5	291.7	398.8	3911.4	85.22	1.1977	96.98
0.0	311.3	0.0	4173.1	100.00	1.1756	100.00

SOLUBILITY OF POTASSIUM BROMIDE AT 25° IN:

Aq. Solutions of KCl and Vice Versa. Aq. Solutions of KI and Vice Versa.
(Amadori and Pampanini, 1911.) (Amadori and Pampanini, 1911.)

Gms. per 100 Gms. H ₂ O.		Gms. per 100 Gms. H ₂ O.	
KBr.	KCl.	KBr.	KI.
68.47	0	53.21	35.92
62.26	5.43	42.32	66.63
58.50	8.46	34.14	95.36
52.45	12.48	30.08	119.52
45.42	17.17	29.62	119
38.70	21.23	22.15	127.10
26.62	25.88	21.88	127.31
12.94	31.02	18.54	130.61
0	36.12	0	149.26

SOLUBILITY OF MIXTURES OF POTASSIUM BROMIDE AND CHLORIDE AND
OF MIXTURES OF POTASSIUM BROMIDE AND IODIDE IN WATER.

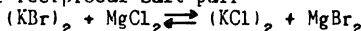
(Etard — Ann. chim. phys. [7] 3, 275, '97.)

Mixtures of KBr and KCl. Mixtures of KBr and KI.

t°.	Grams per 100 Gms. Solution.		Grams per 100 Grams Solution.	
	KBr.	KCl.	KBr.	KI.
-20	17.5	10.5	9.2	42.5
0	21.5	10.8	9.9	45.3
10	23.2	11.0	10.2	46.6
20	24.8	11.2	10.5	47.5
25	25.5	11.3	10.7	48.0
30	26.3	11.4	10.9	48.6
40	28.0	11.5	11.2	49.6
60	30.6	11.8	11.9	51.3
80	33.4	12.1	12.6	52.7
100	35.7	12.6	13.2	53.8
120	38.0	12.9	14.0	54.8
150	40.6	13.4	14.9	55.5

Br

Data for the reciprocal Salt pair



recalculated from the results of Boeke, 1908, and others are given
by Jänecke, 1938.

SOLUBILITY OF POTASSIUM BROMIDE IN AQUEOUS SOLUTIONS OF
POTASSIUM CHLORATE AND VICE VERSA AT 25°.

(Ricci, 1937.)

d of sat. sol.	Gms. per 100 gms. sat. sol.		Solid Phase
	KBr	KClO ₃	
1.380	40.63	0.0	KBr
1.356	40.02	1.42	" + KClO ₃
1.376	39.47	1.42	KClO ₃
1.292	31.66	1.87	"
1.216	24.20	2.41	"
1.160	16.99	3.21	"
1.100	9.30	4.59	"
1.047	0.0	7.905	"

K KALIUM

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SOLUBILITY OF POTASSIUM BROMIDE IN AQUEOUS SOLUTIONS OF POTASSIUM IODATE AND VICE VERSA AT 5°, 25° AND 50°.

(Ricci, 1934.)

d of sat. sol.	Gms. per 100 gms. sat. sol.		Solid Phase	d of sat. sol.	Gms. per 100 gms. sat. sol.		Solid Phase
	KBr	KIO ₃			KBr	KIO ₃	

Results at 5°

1.333	36.25	0.0	KBr
1.352	35.71	1.80	" + KIO ₃
1.290	30.50	1.77	KIO ₃
1.208	22.59	1.80	"
1.136	14.80	1.95	"
1.080	7.58	2.45	"
1.043	0.0	5.186	"

Results at 25° (con.)

1.168	17.40	3.26	KIO ₃
1.106	8.35	4.53	"
1.071	0.0	8.452	"

Results at 50°

—	44.77	0.0	KBr
—	43.88	2.22	"
—	43.50	3.07	" + KIO ₃
—	38.03	3.32	KIO ₃
—	30.57	3.87	"
—	23.19	4.66	"
—	15.65	5.80	"
—	8.18	8.16	"
—	0.0	13.20	"

Results at 25°

1.381	40.62	0.0	KBr
1.396	40.28	0.98	"
1.407	39.75	2.36	" + KIO ₃
1.341	34.38	2.47	KIO ₃
1.294	25.91	2.73	"

SOLUBILITY OF POTASSIUM BROMIDE IN AQUEOUS SOLUTIONS OF POTASSIUM NITRATE, AND OF POTASSIUM NITRATE IN AQUEOUS SOLUTIONS OF POTASSIUM BROMIDE, AT 14.5° AND AT 25.2°.

(Touren — Compt. rend. 130, 908, '00.)

KBr in Aqueous KNO₃ Solutions.

KNO₃ in Aq. KBr Solutions.

Mols. per Liter.		Grams per Liter.		Mols. per Liter.		Grams per Liter.	
KNO ₃ .	KBr.	KNO ₃ .	KBr.	KBr.	KNO ₃ .	KBr.	KNO ₃ .
Results at 14.2°.				Results at 14.20°.			
0.0	4.332	0.0	515.9	0.0	2.228	0.0	225.4
0.362	4.156	36.6	494.9	0.356	2.026	42.4	205.0
0.706	4.093	71.4	487.4	0.784	1.835	93.4	185.7
1.235	3.939	124.9	469.1	1.092	1.730	130.0	175.0
				1.577	1.587	187.8	160.6
				2.542	1.406	302.7	142.2
				3.536	1.308	421.1	132.3
Results at 25.2°.				Results at 25.2°.			
0.0	4.761	0.0	566.2	0.0	3.217	0.0	325.5
0.131	4.72	13.3	561.0	0.38	3.026	45.3	306.2
0.527	4.61	53.3	549.1	0.93	2.689	110.8	272.0
0.721	4.54	72.9	540.8	1.37	2.492	163.1	252.2
1.09	4.475	110.3	533.0	1.208	2.216	143.8	224.3
1.170	4.44	118.4	528.8	2.87	1.958	341.8	198.1
1.504	4.375	152.2	521.1	3.55	1.807	422.8	182.8

SOLUBILITY OF POTASSIUM BROMIDE IN AQUEOUS SOLUTIONS OF POTASSIUM HYDROXIDE.

(Ditte — Compt. rend. 124, 30, '97.)

Grams per 1000 Grams H ₂ O.		Grams per 1000 Grams H ₂ O.	
KOH.	KBr.	KOH.	KBr.
36.4	558.4	277.6	248.1
113.5	433.6	434.7	137.1
177.2	358.1	579.6	64.8
231.1	281.2	806.9	33.4

SOLUBILITY OF POTASSIUM BROMIDE IN AQUEOUS SOLUTIONS OF
POTASSIUM HYDROXIDE AT 20°. (Brönsted, 1920 a.)

Gm. mols. per liter.		Gm. mols. per liter.		Gm. mols. per liter.	
KOH.	KBr.	KOH.	KBr.	KOH.	KBr.
7.90	1.012	12.19	0.348	14.02	0.246
9.41	0.693	12.92	0.306	14.85	0.214
10.95	0.512	13.84	0.247	15.02	0.210
11.10	0.451				

SOLUBILITY OF MIXTURES OF POTASSIUM BROMIDE AND AMMONIUM
BROMIDE IN WATER AT 25°.

(Fock — Z. Kryst. Min. 28, 357, '97.)

Grams per Liter Solution.		Mol. per cent in Solution.		Sp. Gr. of Solutions.	Mol. per cent in Solid Phase.	
NH ₄ Br.	KBr.	NH ₄ Br.	KBr.		NH ₄ Br.	KBr.
0.00	558.1	0.0	100	1.3756	0.00	100
6.4	554.2	1.38	98.62	1.3745	0.26	99.74
24.64	536.5	5.29	94.71	1.3733	1.27	98.73
51.34	516.8	10.77	89.23	1.3721	3.02	96.98
152.9	441.2	29.63	70.37	1.3711	8.42	91.58
262.2	347.3	47.84	52.16	1.3715	17.20	82.80
347.6	262.3	61.69	38.31	1.3753	27.98	72.02
381.4	260.3	64.03	35.97	1.3753	32.53	67.47
417.8	232.2	68.61	31.39	1.3766	39.45	60.55
432.5	222.3	70.27	29.73	1.3777	variable	variable
480.8	179.9	76.47	23.53	1.3766	98.53	1.47
577.3	0.0	100.0	0.0	1.3763	100.0	0.00

Br

SOLUBILITY OF POTASSIUM BROMIDE IN AQUEOUS SOLUTIONS
OF METHYL ALCOHOL AT 25°.

(Akerlof and Turck, 1935.)

Gms. CH ₃ OH per 100 gms. solvent mixture	Gm. Mols. KBr per 1000 gms. solvent mixture	Gms. CH ₃ OH per 100 gms. solvent mixture	Gm. Mols. KBr per 1000 gms. solvent mixture
0.0	5.784	80.03	0.4625
20.0	3.711	89.79	0.2629
40.82	2.180	94.76	0.2049
59.56	1.182	100.0	0.1805
72.39	0.7697		

SOLUBILITY OF POTASSIUM BROMIDE IN AQUEOUS SOLUTIONS OF
ETHYL ALCOHOL AND OF METHYL ALCOHOL. (Zeitlin, 1926.)

The mixtures were agitated frequently by hand during 5 days. The temperatures remained constant to 1°.

Results for Methyl Alcohol.

Wt. per cent CH ₃ OH in solvent.	Gm. mols. K Br per liter at	
	10°.2.	19°.9.
25.96	2.475	2.493
45.13	1.426	1.466
74.88	0.411	0.434
100.00	0.1376	0.142

Results for Ethyl Alcohol.

Wt. per cent C ₂ H ₅ OH in solvent.	Gm. mols. K Br per liter at	
	10°.2.	19°.9.
25.07	2.327	2.437
50.01	1.016	1.161
75.03	0.2704	0.2955
97.03	-	0.0114

100 gms. aq. 50 wt. % ethyl alcohol dissolve 16.4 gms. K Br at 20°.

(Wright, 1926.)

SOLUBILITY OF POTASSIUM BROMIDE IN AQUEOUS SOLUTIONS OF METHYL ALCOHOL AT 25°.

(Herz and Anders, 1907.)

Wt. % CH ₃ OH in Solvent.	Gms. KBr per 100 cc. Sat. Sol.	d_{25}^{25} of Sat. Sol.	Wt. % CH ₃ OH in Solvent.	Gms. KBr per 100 cc. Sat. Sol.	d_{25}^{25} of Sat. Sol.
0	56.04	1.3797	64	10.35	0.9801
10.6	46.28	1.300	78.1	5.24	0.8906
30.8	29.08	1.159	98.9	2.74	0.8411
47.1	19.28	1.058	100	1.69	0.8047

The solubility of potassium bromide in methyl alcohol at the critical temperature is given by Centnerszner (1910), as 0.2 gm. KBr per 100 gms. sat solution.

SOLUBILITY OF POTASSIUM BROMIDE IN DILUTE AQUEOUS ETHYL ALCOHOL.

Results at 0°.

(Armstrong and Eyre, 1910-11.)

Results at 25°.

(Armstrong, Eyre, Hussey and Paddison, 1907.)

Wt. % C ₂ H ₅ OH in Solvent.	Gms. KBr per 100 Gms. Sat. Sol.	Wt. % C ₂ H ₅ OH in Solvent.	Gms. KBr per 100 Gms. Sat. Sol.	d_{25}^{25} of Sat. Sol.
0	34.92	0	40.78	1.3824
1.14	34.35	1.14	39.98	1.3727
2.25	32.96	2.25	39.54	1.3634
4.41	31.99	4.41	38.41	1.3443
8.44	29.43	12.14	34.97	1.2815
		18.73	30.91	1.2322

Br

THE SYSTEM POTASSIUM BROMIDE, TERTIARY BUTYL ALCOHOL AND WATER AT 30°.

(Ginnings and Robbins, 1930.)

The points on the binodal curve of this system were determined by observing the appearance or disappearance in a mixture of weighed amounts of the other. Conjugated points were

The points on the binodal curve of this system were determined by observing the appearance or disappearance of clouding in a mixture of weighed amounts of KBr and one of the liquids, upon addition of a weighed amount of the other. Conjugated points were found by determination of KBr in two liquid phases in contact with each other and from these the plait point (p.p.) was obtained by plotting.

Gms. per 100 gms. mixture		Gms. per 100 gms. mixture		Gms. per 100 gms. mixture		Gms. per 100 gms. mixture	
(CH ₃) ₃ COH	KBr	(CH ₃) ₃ COH	KBr	(CH ₃) ₃ COH	KBr	(CH ₃) ₃ COH	KBr
70.2	3.1	50.3	6.7	27.7	12.6	11.3	22.6
65.7	4.2	44.7	7.8	25.6	13.4	9.2	25.3
60.7	4.8	42.0	8.7p.p.	20.0	15.7	7.7	28.5
56.9	5.4	35.7	10.0	17.0	17.0	6.8	30.4
53.4	6.1	29.7	11.9	13.4	19.8	6.1	33.1

SOLUBILITY OF POTASSIUM BROMIDE IN AQUEOUS ALCOHOL.

(Taylor — J. Physic. Ch. 1, 724, '96-'97.)

Wt. per cent Alcohol in Solution.	Results at 30°.		Results at 40°.	
	Gms. KBr per 100 Gms.		Gms. KBr per 100 Gms.	
	Sat. Solution.	Solvent.	Sat. Solution.	Solvent.
0	41.62	71.30	43.40	76.65
5	38.98	67.25	40.85	72.70
10	36.33	63.40	38.37	69.00
20	31.09	56.40	33.27	62.30
30	25.98	50.15	28.32	56.45
40	21.24	44.95	23.22	50.46
50	16.27	38.85	18.11	44.25
60	11.50	32.50	13.02	37.40
70	6.90	24.70	7.98	28.90
80	3.09	15.95	3.65	18.95
90	0.87	8.80	1.03	10.45

SOLUBILITY OF POTASSIUM BROMIDE AT 25° IN:

(Herz and Knoch, 1905.)

Aqueous Acetone.					Aqueous Glycerol.					Br
cc. Acetone per 100 cc. Solvent.	Per 100 cc. Sat. Solution.			Sp. Gr. Solutions.	Wt. % Glycerol in Solvent.	KBr per 100 cc. Sol.		Sp. Gr. Solutions.		
	Millimols KBr.	Gms. KBr.	Gms. H ₂ O.			Millimols.	Gms.			
0	481.3	57.3	80.6	1.3793	0	481.3	57.32	1.3793		
20	366.7	43.67	69.5	1.2688	13.28	444.3	52.91	1.3704		
30	310.5	36.98	62.97	1.2118	25.98	404	48.11	1.3655		
40	259	30.85	55.60	1.1558	45.36	340.5	40.55	1.3594		
50	202.9	24.16	47.60	1.0918	54.23	310.4	36.98	1.3580		
60	144.9	17.22	39.15	1.0275	83.84	219.25	26.11	1.3603		
70	95.3	11.35	29.78	0.9591	100	172.65	20.56	1.3691		
80	46.5	5.54	20.10	0.8942						
90	10.1	1.20	10.15	0.8340						

100 gm. acetone dissolve 0.023 gm. KBr at 25°.

(Krug and McElroy — J. anal. Chem. 6, 184, '92.)

100 gms. Glycerol of $d = 1.2326 (= 86.5\%)$ dissolve 20.59 gms. K Br at 20°." " $d = 1.2645 (= 98.5\%)$ " 17.15 " "

(Holm, 1921, 1922.)

100 cc. sat. solution of potassium bromide in ethyl urethan (m. pt. 49°6) contain 0.387 gms. K Br at 60°.

(Stueckgold, 1917.)

THE SYSTEM POTASSIUM BROMIDE ETHYLENE GLYCOL

AND WATER AT 30°.

(Trimble, 1931.)

cc of sat. solution	Gms. per 100 gms. sat. solution		
	KBr	CH ₂ OHCH ₂ OH	H ₂ O
1.3876	41.58	0.0	58.42
1.3417	35.82	12.73	51.45
1.2995	29.64	28.29	42.07
1.2637	23.58	46.08	30.34
1.2338	18.03	65.67	16.30
1.2131	13.68	86.32	0.0

K KALIUM

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SOLUBILITY OF POTASSIUM BROMIDE IN AQUEOUS SOLUTIONS OF DIOXANE AT 25°. (Herz and Lorentz, 1929.)

cc Dioxane per 100cc solvent	Gm. Mol. KBr per liter sat. sol.	Gms. KBr per liter sat. solution
10	4.20	500
20	3.70	440
33	2.90	345

Two liquid layers are formed between 47 and 85 vol. percent Dioxane. The lower contains 2.1 gm. mol. KBr per liter and the upper 0.03 gm. mol. per liter.

SOLUBILITY OF POTASSIUM BROMIDE IN AQUEOUS SOLUTIONS OF URETHAN AT 25°. (Palitzsch, 1928, 1929.)

Gm. Mols. per 1000 gms. H ₂ O $\text{NH}_2\text{COOC}_2\text{H}_5$	KBr	Solid Phase
0.0	5.797	KBr
1.1225	5.616	"
7.215	4.886	"
14.60	4.421	" + $\text{NH}_2\text{COOC}_2\text{H}_5$
53.09	0.0	$\text{NH}_2\text{COOC}_2\text{H}_5$

Br

SOLUBILITY OF POTASSIUM BROMIDE IN ALCOHOLS AT 25°. (de Bruyn — Z. physik. Chem. 10, 783, '92; Rohland — Z. anorg. Chem. 18, 327, '98.)

Alcohol.	Grams KBr Dissolved by 100 Gms. Alcohol at:	
	Room Temp. (R.).	25° (de B.).
Methyl Alcohol	1.92	1.51 Abs. Alcohol
Ethyl Alcohol	0.28 (Sp. Gr. 0.81)	0.13 "
Propyl Alcohol	0.055	...
100 gms. methyl alcohol dissolve 2.17 gms. KBr at 25°. (Turner and Bissett, 1913.)		
" ethyl "	0.142 gm.	" "
" propyl "	0.035 "	" "
" amyl "	0.003 "	" "

SOLUBILITY OF POTASSIUM BROMIDE IN METHYL ALCOHOL.

(Lloyd, Brown, Glynwyn, Bonnell and Jones, 1928.)

t°	Gms. KBr per 100 gms. CH ₃ OH	t°	Gms. KBr per 100 gms. CH ₃ OH
0	1.82	30	2.23
10	1.93	40	2.37
15	2.00	50	2.55
20	2.08	60	2.74

SOLUBILITY OF POTASSIUM BROMIDE IN METHYL ALCOHOL, ETHYL ALCOHOL AND n-BUTYL ALCOHOL.

(Germuth, 1931.)

t°	Gms. KBr per 100 gms. sat. solution in:		
	CH ₃ OH	C ₂ H ₅ OH	CH ₃ (CH ₂) ₃ CH ₂ OH
20	2.542	0.453	0.0112
30	2.496	0.501	0.0130
40	2.440	0.563	0.0137
50	2.316	0.568	0.0148
55	2.222	0.575	0.0150

SOLUBILITY OF POTASSIUM BROMIDE IN WATER AND IN SEVERAL ALCOHOLS AT 25°.
(Larson and Hunt, 1939.)

Solvent	Formula	d of sat. sol.	Gms. KBr per 100 gms. solvent
Water	H ₂ O	—	67.75
Methanol	CH ₃ OH	0.8025	2.11
Ethanol	C ₂ H ₅ OH	0.7861	0.135
1-Propanol	CH ₃ CH ₂ CH ₂ OH	0.8010	0.0314
1-Butanol	CH ₃ (CH ₂) ₂ CH ₂ OH	0.8058	0.0132
2-Propanol	CH ₃ CHOHCH ₃	0.7810	0.0110
2-Methyl-1-propanol	(CH ₃) ₂ CHCH ₂ OH	0.7980	0.0076
1-Pentanol	CH ₃ (CH ₂) ₃ CH ₂ OH	0.8096	0.0048
2-Butanol	CH ₃ CH ₂ CHOHCH ₃	0.8022	0.0044

SOLUBILITY OF POTASSIUM BROMIDE IN ACETONE.
(Lanning, 1932.)

t°	d of sat. sol.	Gm. Mol. KBr per liter sat. sol.	Gms. KBr per liter sat. sol.
18	0.792	0.000239	0.0359
37	0.770	0.000212	0.0328

SOLUBILITY OF POTASSIUM BROMIDE IN ACETONE AND IN ACETONE
SOLUTIONS OF SEVERAL SALTS AT 25°.
(Robinson, 1928.)

Added Salt	Gm. Equiv. salt per liter	Gm. Equiv. KBr per liter sat. sol.	Added Salt	Gm. Equiv. salt per liter	Gm. Equiv. KBr per liter sat. sol.
None (= Pure Acetone)		0.000369	0.044gm KI	0.000343	0.000414
BaBr ₂	0.000240	0.000430	"	0.000877	0.000489
"	0.000730	0.000482	"	0.001763	0.000579
"	0.001206	0.000531	NaI	0.000382	0.000418
BaI ₂	0.000137	0.000424	"	0.000939	0.000494
"	0.000408	0.000510	"	0.001849	0.000571
"	0.001206	0.000623	"	0.003542	0.000657

SOLUBILITY OF POTASSIUM BROMIDE IN 95% ETHYL ALCOHOL
CONTAINING INCREASING AMOUNTS OF HYDROBROMIC ACID AT 25°.
(Yagoda, 1930.)

Normality of HBr in 95% C ₂ H ₅ OH	d of sat. sol.	Gms. KBr per 100 gms. solvent	Normality of HBr in 95% C ₂ H ₅ OH	d of sat. sol.	Gms. KBr per 100 gms. solvent
0.0	0.7997	0.289	0.400	0.839	0.176
0.05	0.805	0.191	0.537	0.853	0.186
0.10	0.810	0.165	0.800	0.878	0.190
0.204	0.820	0.162	0.954	0.893	0.242

The composition of the homogeneous mixture (plait point) of the system composed of:

Potassium Bromide + tertiary Butyl Alcohol + Water at 25° was found by Ginnings, Herring and Webb, 1933, to be:

11.5 percent KBr + 35.1 percent ter. (CH₃)₃COH + 53.4 percent H₂O

The original results for the remaining points of the binodal curve are not given but only the values of a series of arbitrary constants calculated from them by means of empirical equations.

SOLUBILITY OF POTASSIUM BROMIDE IN SEVERAL SOLVENTS.

Solvent	Formula	t°	Gms. KBr per 100 gms. solvent	Authority
Formic Acid (95%)	HCOOH	18.5	23.2	(Aschan, 1913.)
Furfural	C ₄ H ₃ OCHO	25	0.12	(Walden, 1906.)
Iso Amyl Alcohol	(CH ₃) ₂ CH(CH ₂) ₂ OH	25	0.00175	(Yagoda, 1930.)
Hydroxylamine	NH ₂ OH	17-18	44.7	(de Bruyn, 1892.)
Hydrazine	NH ₂ .NH ₂	Ca20	60.0	(Welsh and Broderson, 1915.)
Ammonia (liquid)	NH ₃	-33.9 (d=0.9098)	40.32	(Johnson and Kromboltz, 1933.)
"	"	0	26.87	(Linhard and Stephen, 1933, 1934.)
"	"	25	13.50	(Hunt, 1932.)
Sulfur Dioxide (liquid)	SO ₂	0	2.81	(Jander and Ruppolt, 1937.)

FUSION-POINT DATA FOR MIXTURES OF KBr AND OTHER SALTS.

Br	KBr + KF	(Kurnakow and Wrzesnewsky, 1912; Ruff and Plato, 1903.)
	KBr + KCl	(Wrzesnewsky, 1912; Amadori and Pampanini, 1911; Ruff and Plato, 1903; Tammann and Krings, 1923.)
	KBr + KI	(Wrzesnewsky, 1912; Amadori and Pampanini, 1911; Ruff and Plato, 1903.)
	KBr + NaCl	(Ruff and Plato, 1903.)
	KBr + KOH	(Scarpa, 1915.)
	KBr + KNO ₃	" "
	KBr + RbCl	(Tammann and Krings, 1923.)
	KBr + SrBr ₂	(Kellner, 1917.)
	KBr + TlBr	(Rostowski, 1929.)
	KBr + TlNO ₃	" "

POTASSIUM Iodo dibROMIDE KIBr₂

One gm. H₂O dissolves 10-12 gms. KIBr₂, at 18°.

One liter sat. solution of Potassium iodo di bromide in carbon tetrachloride, contain 0.0473 gm. mol. (?) KIBr₂ at 25°. (Cremer and Duncan, 1931.)

POTASSIUM StannoBROMIDES Mono KSnBr₃.H₂O, Tetra K₄SnBr₄.H₂O.

SOLUBILITY OF MONO POTASSIUM STANNO BROMIDE IN WATER.

(Rimbach and Fleck, 1916.)

t°.	Gms. per 100 gms. sat. sol.				Solid Phase.
	Br	+	Sn	+ K = SnBr ₃ K	
0.2°.....	11.21		3.88	2.94	KSnBr ₃ .H ₂ O + SnBr ₃ .H ₂ O
17.1°.....	16.17		6.05	3.94	" "
36.3°.....	24.56		10.84	4.90	" "
46.3°.....	30.83		15.22	5.09	KSnBr ₃ .H ₂ O
74.6°.....	40.88		20.24	6.70	"

SOLUBILITY OF TETRA POTASSIUM STANNO BROMIDE IN WATER.

(Rimbach and Fleck, 1916.)

t°.	Gms. per 100 gms. sat. sol.				Solid Phase.
	Br	+	Sn	+ K	
0.3°.....	19.26		1.00	8.77	K ₄ SnBr ₄ .H ₂ O + SnBr ₃ .H ₂ O
16.4°.....	28.62		2.33	12.48	" "
43.3°.....	33.38		4.28	13.52	" "
62.1°.....	39.43		8.44	13.75	" "
77.1°.....	43.76		12.73	13.03	" "

* At these temperatures the atomic ratios of the constituents in solution do not correspond to

SOLUBILITY IN WATER.

(Kremers — Pogg. Ann. 97, 5, '56; Rammelsberg — *Ibid.* 55, 79, '42; Pohl — Sitzber. Akad. Wiss Wien. 6, 595, '51.)

t°.	Gms. KBrO_3 per 100 Gms.		t°.	Gms. KBrO_3 per 100 Gms.	
	Water.	Solution.		Water.	Solution.
0	3.1	3.0	40	13.2	11.7
10	4.8	4.6	50	17.5	14.9
20	6.9	6.5	60	22.7	18.5
25	8.0	7.4	80	34.0	25.4
30	9.5	8.7	100	50.0	33.3

Sp. Gr. of solution saturated at 19.5° = 1.05.

The following more recent determinations are by Ricci, 1934.

t°	d of sat. solution	Gms. KBrO_3 per 100 gms. sat. sol.	t°	d of sat. solution	Gms. KBrO_3 per 100 gms. sat. sol.
5	1.024	3.642	30	1.062	8.785
10	1.035	4.510	35	1.074	10.13
15	1.042	5.397	40	1.083	11.58
20	1.048	6.460	45	—	13.08
25	1.054	7.533	50	—	14.69

BrO

The following determinations of the solubility of Potassium Bromate in Water at temperatures above 100°, made by the synthetic method, are given by Benrath, Gjedebo, Schiffers and Wunderlich, 1937.

t°	Gms. KBrO_3 per 100 gms. sat. sol.	t°	Gms. KBrO_3 per 100 gms. sat. sol.	t°	Gms. KBrO_3 per 100 gms. sat. sol.
134	43.6	186	59.9	265	77.2
149	48.4	204	64.2	279	81.1
160	51.1	226	70.6	297	83.1
170	54.1	249	72.6	312	86.4

EQUILIBRIUM IN THE SYSTEM POTASSIUM BROMATE, POTASSIUM CHLORATE AND WATER AT 25°.

(Swenson and Ricci, 1939.)

d. of sat. sol.	Gms. per 100 gms. sat. sol.		Solid Phase	d. of sat. sol.	Gms. per 100 gms. sat. sol.		Solid Phase
	KBrO_3	KClO_3			KBrO_3	KClO_3	
1.054	7.533	0.0	KBrO_3	1.072	4.02	6.75	SS2 (96.0)
—	6.46	2.26	SS1 (0.46)	1.064	2.79	7.08	" (97.2)
1.067	5.75	4.08	" (1.10)	—	2.07	7.26	" (98.3)
—	5.63	4.29	" (2.0)	1.053	1.02	7.60	" (99.1)
1.078	4.945	6.531	" + SS2	1.048	0.0	7.895	KClO_3

SS1 = Solid Solution of KClO_3 in KBrO_3 with a limit of 3% KClO_3 .

SS2 = Solid Solution of KBrO_3 in KClO_3 with a limit of 5% KBrO_3 .

The figures in parentheses show the percentage of KClO_3 in the solid solutions.

SOLUBILITY OF POTASSIUM BROMATE AT 25° IN AQUEOUS SOLUTIONS OF:
(Ricci, 1934.)

Potassium Chloride				Potassium Iodide			
d of sat. sol.	Gms. per 100 KBrO ₃	gms. sat. sol. KCl	Solid Phase	d of sat. sol.	Gms. per 100 KBrO ₃	gms. sat. sol. KCl	Solid Phase
1.054	7.533	0.0	KBrO ₃	1.054	7.533	0.0	KBrO ₃
1.058	4.63	4.33	"	1.103	4.54	8.77	"
1.082	3.24	9.03	"	1.182	2.96	18.85	"
1.112	2.44	14.45	"	1.278	2.17	28.60	"
1.147	1.97	19.71	"	1.402	1.63	38.99	"
1.183	1.65	24.87	"	1.565	1.21	50.06	"
1.192	1.61	25.89	" + KBr	1.707	0.99	58.14	"
1.187	1.48	25.93	KBr	1.729	0.96	59.20	" + KI
1.179	0.0	26.36	"	1.718	0.0	59.76	KI

BrO	Potassium Nitrate				Potassium Sulfate			
	d of sat. sol.	Gms. per 100 KBrO ₃	gms. sat. sol. KNO ₃	Solid Phase	d of sat. sol.	Gms. per 100 KBrO ₃	gms. sat. sol. K ₂ SO ₄	Solid Phase
	1.074	5.61	5.05	KBrO ₃	1.066	6.08	2.67	KBrO ₃
	1.110	4.64	11.10	"	1.083	5.02	5.44	"
	1.148	4.23	16.98	"	1.100	4.27	8.20	"
	1.193	4.00	23.17	"	1.108	4.00	9.35	" + K ₂ SO ₄
	1.225	3.90	27.01	" + KNO ₃	1.103	3.40	9.45	K ₂ SO ₄
	1.211	2.64	27.27	KNO ₃	1.094	1.69	10.12	"
	1.193	0.0	27.71	"	1.083	0.0	10.76	"

SOLUBILITY OF POTASSIUM BROMATE IN AQUEOUS SOLUTIONS OF VARIOUS
COMPOUNDS AT 25°.
(Rothmund, 1910.)

Solvent, 0.5 Normal Aq. Sol. of:	Mols. KBrO ₃ per Liter.	Gms. KBrO ₃ per Liter.	Solvent, 0.5 Normal Aq. Sol. of:	Mols. KBrO ₃ per Liter.	Gms. KBrO ₃ per Liter.
Water alone	0.478	79.84	Dimethylpyrone	0.478	79.84
Methyl Alcohol	0.444	74.16	Ammonia	0.445	74.33
Ethyl Alcohol	0.421	70.33	Dimethylamine	0.384	64.13
Propyl Alcohol	0.409	68.31	Pyridine	0.415	69.31
Tertiary Amyl Alcohol	0.383	63.97	Piperidine	0.396	66.15
Acetone	0.425	70.99	Urethan	0.433	72.33
Ethyl Ether	0.395	65.98	Formamide	0.473	79.02
Formaldehyde	0.397	66.31	Acetamide	0.445	74.33
Glycol	0.448	74.84	Glyocol	0.501	83.68
Glycerol	0.451	75.34	Acetic Acid	0.456	76.17
Mannitol	0.451	75.34	Phenol	0.426	71.15
Grape Sugar	0.431	71.99	Methylal	0.405	67.66
Urea	0.477	79.68	Methyl Acetate	0.420	70.15

SOLUBILITY OF POTASSIUM BROMATE IN AQUEOUS SOLUTIONS OF SODIUM NITRATE AND OF SODIUM CHLORIDE.

(Geffcken — Z. physik. Chem. 49, 296, '04.)

In Sodium Nitrate.

Grams per Liter.		Mols. KBrO ₃ per Liter.
NaNO ₃ .	KBrO ₃ .	
0.0	78.79	0.4715
42.54	96.01	0.5745
85.09	108.6	0.6497
170.18	128.3	0.7680
255.27	150.9	0.9026
340.36	172.3	1.031

In Sodium Chloride.

Grams per Liter.		Mols. KBrO ₃ per Liter.
NaCl.	KBrO ₃ .	
0.0	78.79	0.4715
29.25	82.24	0.5220
58.50	93.87	0.5616
117.0	100.9	0.6042
175.5	104.3	0.6244
234.0	106.9	0.6400

BrO

100 gms. liquid Ammonia dissolve 0.002 gm. KBrO₃ at 25°. (Hunt and Boncyk, 1933.)

POTASSIUM METHIONATE K₂[CH₂·(SO₃)₂]

100 gms. sat. solution of Potassium Methionate in Water contain 4.46 gms. K₂[CH₂(SO₃)₂] at 25°. (Backer, 1929; Baker and Terpstra, 1929.)

POTASSIUM Chlor METHIONATE K₂[CHCl(SO₃)₂]

100 gms. sat. solution of Potassium Chlor Methionate in water contain 34.2 gms. K₂[CHCl(SO₃)₂] at 25°. (Baker, 1930.)

POTASSIUM FORMATE HCOOK.

Determinations of the freezing-points of aqueous solutions of potassium formate made in a Beckmann apparatus, gave the following results.

t°.....	-2.62.	-6.72.	-10.42.	-15.82.	-17.39.
Gms. HCOOK per 100 gms. sat. sol...	5.71	12.95	18.42	25.03	26.04

CH

The solid phase was ice in all cases.

(Sidgwick and Gentle, 1922.)

SOLUBILITY OF POTASSIUM FORMATE AND OF THE ACID SALT IN WATER.

(Groschuff, 1903.)

Solid Phase : HCOOK.				Solid Phase : HCOOK.HCOOH.			
t°.	Gms. HCOOK per 100 Gms. Solution.	Mols. HCOOK per 100 Mols. H ₂ O.		t°.	Gms. HCOOK- HCOOH per 100 Gms. Solution.	Gms. HCOOK per 100 Gms. Solution.	
							Gms. HCOOK per 100 Gms. Solution.
- 20	72.8	57.4		0	60.4	39.0	35.3
+ 18	76.8	71.0		25	69.8	45.1	38.2
50	80.7	89.8		50	79.2	51.2	40.8
90	86.8	141.0		80	90.7	58.6	44.0
120	92.0	247.0					45.9
140	96.0	511					52.1
157	100.0	∞					

Sp. Gr. of sat. solution at 18° = 1.573.

NOTE. — Since the acid salt is less soluble at ordinary temperatures than the neutral salt, it can be precipitated from the solution of the neutral salt by addition of aqueous formic acid. Proceeding in this way an impure product is obtained, giving solubility values (expressed in HCOOK) as shown in the last three columns above.

Freezing-point data for the system HCOOK + HCOOH are given by Kendall and Adler, 1921.

K KALIAM ⁷⁰⁰ POTASSIUM ACETATE CH₃COOK.

Determinations of the freezing-points of aqueous solutions of potassium acetate made in a Beckmann apparatus gave the following results :

t°.....	-2.15.	-3.36.	-9.32.	-12.32.	-17.92.
Gms. CH ₃ COOK per 100 gms. sat. sol...	5.00	7.42	17.04	20.53	25.5

The solid phase was ice in all cases.

(Sidgwick and Gentle, 1922.)

100 gms. aq. 86.5 % Glycerol ($d = 1.2326$) dissolve 77.4 gms. CH₃COOK at 20°.

" " 98.5 % " ($d = 1.2645$) " 65.5 " "

(Holm, 1921, 1922.)

Data for the freezing-points of mixtures of potassium acetate (m. pt. 295) and sodium acetate (m. pt. 320) are given by Baskof, 1915, 1917. The salts form solid solutions in all proportions and no eutectic point was obtained. The lowest i. pt., 233°, was found for a mixture containing 46 mol. per cent CH₃COONa.

Data for the freezing-points of mixtures of potassium acetate and lead acetate are given by Lehrman and Leifer, 1938.

POTASSIUM ACETATE CH₃COOK.1½H₂O.

SOLUBILITY IN WATER. (Abe, 1911.)

t°.	Gms. CH ₃ COOK per 100 Gms. H ₂ O.	Solid Phase.	t°.	Gms. CH ₃ COOK per 100 Gms. H ₂ O.	Solid Phase.
0.1	216.7	2CH ₃ COOK.3H ₂ O	41	327.7	2CH ₃ COOK.3H ₂ O
5	223.9	"	41.3 tr. pt.	...	" + 2CH ₃ COOK.H ₂ O.
10	233.9	"	42	329	2CH ₃ COOK.H ₂ O
15	243.1	"	45	332.2	"
20	255.6	"	50	337.3	"
25	269.4	"	60	350	"
30	283.8	"	70	364.8	"
35	301.8	"	80	380.1	"
38	314.2	"	90	396.3	"
40	323.3	"	96	406.5	"

CH

SOLUBILITY OF POTASSIUM ACETATE IN AQ. ALCOHOL SOLUTIONS AT 25°. (Seidell, '10.)

Wt. % C ₂ H ₅ OH in Solvent.	d ₄ of Sat. Sol.	Gms. CH ₃ COOK per 100 Gms. Solvent.	Wt. % C ₂ H ₅ OH in Solvent.	d ₄ of Sat. Sol.	Gms. CH ₃ COOK per 100 Gms. Solvent.
0	1.417	219.6	70	1.156	118.3
20	1.363	219.6	80	1.085	87.6
40	1.302	192.4	90	0.990	52.9
50	1.260	171.8	95	0.922	34.2
60	1.210	147.5	100	0.850	16.3

SOLUBILITY OF POTASSIUM ACETATE IN ACETIC ACID, DETERMINED BY THE FREEZING-POINT METHOD.

(Davidson and McAllister, 1930.)

t°	Gm. Mols. CH ₃ COOK per 100 gm. mols. mixture	Solid Phase	t°	Gm. Mols. CH ₃ COOK per 100 gm. mols. mixture	Solid Phase
16.50	0.0	CH ₃ COOH	110.0	30.67	1.1
15.82	1.22	"	118.0	32.47	"
10.95	6.70	"	124.5	34.41	"
7.45	9.10	"	126.0	35.27	"
5.95	10.03	"	137.0	39.5	"
14.76	10.97	1.2	145.0	44.88	"
28.03	12.71	"	147.5	48.30	"
49.90	15.75	"	148.0	50.22	"
64.1	18.71	"	147.5	52.32	"
73.5	20.48	"	170	58.45	CH ₃ COOK
83.6	23.85	"	206	64.16	"
99.0	28.44	1.1	245	76.50	"
			292	100.00	"

1.2 = CH₃COOK.2CH₃COOH; 1.1 = CH₃COOK.CH₃COOH

The following results, differing from the above were obtained by Bakunin and Vitale, 1935.

t°	Gm. Mols. CH ₃ COOK per 100 gm. mols. mixture	Solid Phase	t°	Gm. Mols. CH ₃ COOK per 100 gm. mols. mixture	Solid Phase
16	0.0	CH ₃ COOH	134	42.88	2.1
9	5.23	"	138.6	50.06	"
3	10.33	"	147	58.05	CH ₃ COOK
0 Eutec.	—	" + 1.2	175	60.20	"
14	16.22	1.2	234	71.83	"
64	23.43	2.1	258	81.73	"
101	29.43	"	292	98.24	"
112	37.27	"	297	100.00	"

100 gms. methyl alcohol (CH₃OH) dissolve 24.24 gms. CH₃COOK at 15° and 53.54 gms. at 73.4° (= b. pt. of the sat. sol.). The salt gives extremely hygroscopic crystals of the alcoholate, CH₃COOK·CH₃OH. (Henstock, 1934.)

100 gms. liquid Ammonia dissolve 1.026 gm. CH₃COOK at -33.9°. (Johnson and Krumboltz, 1933.)

100 gms. liquid Sulfur Dioxide dissolve 0.006 gm. CH₃COOK at 0°. (Jander and Ruppolt, 1937.)

POTASSIUM PROPIONATE C₂H₅COOK·H₂O

C₂H

100 gms. methyl alcohol (CH₃OH) dissolve 39.0 gms. anhydrous potassium propionate at 15° and 55.33 gms. at 71.3° (= b. pt. of sat. sol.). (Henstock, 1934.)

POTASSIUM BUTYRATE C₄H₇COOK.

100 gms. water dissolve 296.8 gms. C₄H₇COOK, or 100 gms. sat. solution contain 74.8 gms. at 31.25°.

100 gms. of an aq. solution saturated with sugar and C₄H₇COOK contain 49.19 gms. sugar + 34.78 gms. C₄H₇COOK + 16.03 gms. H₂O at 31.25°. (Köhler, 1897.)

100 gms. methyl alcohol (CH₃OH) dissolve 51.04 gms. n potassium butyrate, CH₃CH₂CH₂COOK, at 15° and 120.84 gms. at 70.9° (= b. pt. sat. sol.). (Henstock, 1934.)

POTASSIUM Iso BUTYRATE (CH₃)₂CHCOOK

EQUILIBRIUM IN THE SYSTEM POTASSIUM Iso BUTYRATE, Iso BUTYRIC ACID AND WATER AT 25°.

(Bury and Mendis, 1939.)

Suitable mixtures were shaken in hard glass vessels until analysis showed that equilibrium was established. Iso butyric acid was determined by titration and potassium iso butyrate by conversion into potassium chloride. The two liquid layers which were formed in all cases had the following compositions.

Upper Layer		Lower Layer		Upper Layer		Lower Layer	
Gms. per 100 gms.		Gms. per 100 gms.		Gms. per 100 gms.		Gms. per 100 gms.	
sat. sol.		sat. sol.		sat. sol.		sat. sol.	
1C ₄ H ₈ O ₂	1C ₄ H ₇ O ₂ K	1C ₄ H ₈ O ₂	1C ₄ H ₇ O ₂ K	1C ₄ H ₈ O ₂	1C ₄ H ₇ O ₂ K	1C ₄ H ₈ O ₂	1C ₄ H ₇ O ₂ K
57.26	0	24.0	0	51.20	0.20	30.17	0.32
57.08	0.02	24.23	0.09	49.81	0.23	30.99	0.33
56.90	0.05	25.09	0.18	49.00	0.24	31.21	0.34
55.54	0.08	26.43	0.23	47.91	0.26	31.80	0.34
54.76	0.10	27.14	0.25	46.89	0.28	32.56	0.34
53.81	0.13	27.72	0.27	45.72	0.29	34.02	0.35
53.17	0.16	28.00	0.28	44.54	0.30	35.21	0.36
52.50	0.18	29.03	0.29	43.48	0.32	37.62	0.36
51.72	0.19	29.69	0.30	42.00	0.34	39.57	0.37
51.11	0.20	30.08	0.32				

POTASSIUM TARTRATE (Mono) $\text{KHC}_4\text{H}_4\text{O}_6$, Cream of Tartar.**SOLUBILITY OF MONO POTASSIUM TARTRATE IN WATER.**

(Alluard, 1865; Roelofsen, 1894; Blarez, 1891; at 20°, Magnanini, 1901; at 25°, Noyes and Clement, 1894.)

t°.	Gms. $\text{KHC}_4\text{H}_4\text{O}_6$ per 100 Gms. Solution.			t°.	Gms. $\text{KHC}_4\text{H}_4\text{O}_6$ per 100 Gms. Solution.		
0	0.30 (R.)	0.32 (A.)	0.35 (B.)	40	0.96	1.3	1.29
10	0.37	0.40	0.42	50	1.25	1.8	1.80
20	0.49	0.53 (M.)	0.60	60	...	2.4	...
25	0.58	0.654 (N. and C.)	0.74	80	...	4.4	...
30	0.69	0.9 (A.)	0.89	100	...	6.5	...

POTASSIUM TARTRATE (Mono) $(\text{CH OH})_2\text{COOH.COOK}$ (Cream of Tartar).**SOLUBILITY OF MONO POTASSIUM TARTRATE IN WATER.**

(Paul, [at 18°, 1917] 1926.)

NOTE. — A weighed amount of dried tartaric was shaken with a weighed amount of water a given time in a thermostat. The undissolved salt was filtered on a Gooch crucible, dried over phosphorus pentoxide and weighed. Furthermore the content of the solution was determined by titration with standard barium hydroxide solution.

t°.	$d_{\frac{t}{4}}^t$ of sat. sol.		Gms. $\text{KHC}_4\text{H}_4\text{O}_6$ per 100 cc. sat. sol.	t°.	$d_{\frac{t}{4}}^t$ of sat. sol.		Gms. $\text{KHC}_4\text{H}_4\text{O}_6$ per 100 gms. sat. sol.
0.....	1.00145		0.2653	18.....	1.00120		0.4896
5.....	1.00224		0.2975	20.....	1.00100		0.5337 (0.5415) ⁽²⁾
10.....	1.00180		0.3663	25.....	1.00079		0.6412
14.....	1.00172		0.4301 (4.8) ⁽¹⁾	30.....	1.00026		0.7623

(1) This result is by Pierrat, 1921; (2) This result is by Moser and Ritschel, 1925.

Later very careful determinations by Carpenter and Mack, 1934, gave the following results:

t°	d of sat. sol.	Gms. $\text{KHC}_4\text{H}_4\text{O}_6$ per 100 gms. sat. sol.	t°	d of sat. sol.	Gms. $\text{KHC}_4\text{H}_4\text{O}_6$ per 100 gms. sat. sol.
0	1.0012	0.2305	15	1.0016	0.4338
5	1.0016	0.2870	20	1.0012	0.5323
10	1.0020	0.3579	25	1.0003	0.6412

SOLUBILITY OF MONO POTASSIUM TARTRATE IN AQUEOUS SOLUTIONS OF NEUTRAL DIPOTASSIUM TARTRATE AT 20°.

(Richert, 1930.)

Gm. Mols. per liter of sat. solution		Gm. Mols. per liter of sat. solution	
$\text{K}_2\text{C}_4\text{H}_4\text{O}_6$	$\text{KHC}_4\text{H}_4\text{O}_6$	$\text{K}_2\text{C}_4\text{H}_4\text{O}_6$	$\text{KHC}_4\text{H}_4\text{O}_6$
0.000	0.0284 (= 5.342 gms.)	0.00443	0.00667
0.000443	0.0218 ¹	0.00714	0.00540
0.000886	0.0176	0.0143	0.00360
0.00177	0.0124	0.0214	0.00280
0.00266	0.0096	0.0286	0.00264
0.00354	0.00805	0.0357	0.00260

POTASSIUM Acid TARTRATE $\text{KHC}_4\text{H}_4\text{O}_6$

SOLUBILITY OF MONO POTASSIUM TARTRATE IN AQUEOUS SOLUTIONS
OF NEUTRAL DI POTASSIUM TARTRATE AT SEVERAL TEMPERATURES.
(Carpenter and Mack, 1934.)

Gms. $\text{K}_2\text{C}_4\text{H}_4\text{O}_6$ per 100 gms. sat. sol.	Gms. $\text{KHC}_4\text{H}_4\text{O}_6$ per 100 gms. sat. solution at:		
	0°	5°	10°
0.00	0.2305 (1.0012)	0.2870 (1.0016)	0.3579 (1.0020)
0.025	0.2010 (1.0010)	0.2562 (1.0016)	0.3272 (1.0020)
0.050	0.1772 (1.0009)	0.2322 (1.0017)	0.3000 (1.0021)
0.100	0.1394 (1.0011)	0.1936 (1.0021)	0.2557 (1.0024)
0.200	0.0978 (1.0014)	0.1437 (1.0025)	0.1924 (1.0027)
0.300	0.0758 (1.0018)	0.1098 (1.0029)	0.1540 (1.0030)
0.400	0.0617 (1.0024)	0.0902 (1.0035)	0.1317 (1.0036)
0.500	0.0523 (1.0031)	0.0784 (1.0041)	0.1143 (1.0042)
0.600	0.0480 (1.0038)	0.0703 (1.0047)	0.1039 (1.0048)
0.700	0.0433 (1.0046)	0.0638 (1.0053)	0.0935 (1.0054)
0.800	0.0379 (1.0052)	0.0562 (1.0059)	0.0824 (1.0060)

Gms. $\text{K}_2\text{C}_4\text{H}_4\text{O}_6$ per 100 gms. sat. sol.	Gms. $\text{KHC}_4\text{H}_4\text{O}_6$ per 100 gms. sat. solution at:		
	15°	20°	25°
0.00	0.4338 (1.0014)	0.5323 (1.0012)	0.6412 (1.0003)
0.025	0.4050 (1.0017)	0.5010 (1.0012)	0.6120 (1.0003)
0.050	0.3793 (1.0017)	0.4737 (1.0013)	0.5894 (1.0004)
0.100	0.3307 (1.0018)	0.4228 (1.0014)	0.5424 (1.0006)
0.200	0.2651 (1.0021)	0.3492 (1.0016)	0.4560 (1.0008)
0.300	0.2186 (1.0025)	0.2939 (1.0020)	0.3898 (1.0011)
0.400	0.1890 (1.0028)	0.2532 (1.0021)	0.3428 (1.0015)
0.500	0.1652 (1.0031)	0.2208 (1.0023)	0.3060 (1.0020)
0.600	0.1492 (1.0037)	0.1977 (1.0025)	0.2773 (1.0022)
0.700	0.1357 (1.0041)	—	0.2522 (1.0024)
0.800	0.1220 (1.0149)	—	0.2292 (1.0028)

C₄H

The figures in parentheses are the densities of the saturated solutions.

SOLUBILITY OF MONO POTASSIUM TARTRATE IN AQUEOUS
SOLUTIONS OF TARTARIC ACID AT 20°.
(Richert, 1930.)

Gm. Mols. per liter sat. solution	
$\text{H}_2\text{C}_4\text{H}_4\text{O}_6$	$\text{KHC}_4\text{H}_4\text{O}_6$
0.0030	0.0268
0.0055	0.0260
0.0105	0.0240
0.0335	0.0238
0.0485	0.0238

SOLUBILITY OF MONO POTASSIUM TARTRATE IN AQUEOUS SOLUTIONS
OF TARTARIC ACID AT SEVERAL TEMPERATURES.

(Carpenter and Mack, 1934.)

Gms. $\text{H}_2\text{C}_4\text{H}_4\text{O}_6$ per 100 gms. sat. sol.	Gms. $\text{KHC}_4\text{H}_4\text{O}_6$ per 100 gms. sat. solution at:		
	0°	10°	25°
0.0	0.2305 (1.0012)	0.03579 (1.0020)	0.6412 (1.0003)
0.025	0.2162 (1.0013)	0.3457 (1.0020)	0.6220 (1.0003)
0.050	0.2075 (1.0013)	0.3352 (1.0021)	0.6063 (1.0004)
0.100	0.1962 (1.0014)	0.3205 (1.0021)	0.5842 (1.0005)
0.200	0.1842 (1.0016)	0.3003 (1.0026)	0.5558 (1.0008)
0.400	0.1680 (1.0024)	0.2715 (1.0033)	0.5243 (1.0014)
0.600	0.1600 (1.0035)	0.2502 (1.0042)	0.4981 (1.0021)
0.800	0.1503 (1.0047)	—	0.4716 (1.0027)

The figures in parentheses are the densities of the saturated solutions.

SOLUBILITY OF MONO POTASSIUM TARTRATE ($\text{KHC}_4\text{H}_4\text{O}_6$) IN NORMAL
SOLUTIONS OF ACIDS AT 20°.

(Ostwald; Huecke, 1884.)

Purified tartrate was added in excess to normal solutions of the acids, and, after shaking, clear 1 cc. portions of each solution were withdrawn and titrated with approximately 0.1 N $\text{Ba}(\text{OH})_2$ solution; 1 cc. normal acid requiring 10.63 cc. of the $\text{Ba}(\text{OH})_2$ solution.

C₄H

Acid.	Gms. Acid per 100 cc. Solvent.	cc. N/10 $\text{Ba}(\text{OH})_2$ per 1 cc. Solution.	Gms. $\text{KHC}_4\text{H}_4\text{O}_6$ per 100 cc. Solution.	Acid.	Gms. Acid per 100 cc. Solvent.	cc. N/10 $\text{Ba}(\text{OH})_2$ per 1 cc. Solution.	Gms. $\text{KHC}_4\text{H}_4\text{O}_6$ per 100 cc. Solution.
HNO_3	6.31	5.77*	10.21	$\text{C}_2\text{H}_5\text{SO}_3\text{H}$	11.0	5.01*	8.87
HCl	3.65	5.32	9.42	$\text{HO}(\text{CH}_2)_2\text{SO}_3\text{H}$	12.61	5.33	9.43
HBr	8.10	5.38	9.75	$\text{C}_6\text{H}_5\text{SO}_3\text{H}$	15.81	5.25	9.29
HI	12.80	5.43	9.61	HCOOH	4.60	0.45	0.80
H_2SO_4	4.90	3.97	7.03	CH_3COOH	6.00	0.27	0.48
HCH_2SO_4	11.21	5.58	12.44	CH_2ClCOOH	9.45	1.01	1.79
$\text{HC}_2\text{H}_3\text{SO}_4$	12.61	5.41	9.58	$\text{C}_2\text{H}_3\text{COOH}$	7.40	0.24	0.42
$\text{HC}_3\text{H}_3\text{SO}_4$	14.01	5.21	9.22	$\text{C}_3\text{H}_7\text{COOH}$	8.81	0.23	0.41

* The figures in this column show the amount of the $\text{Ba}(\text{OH})_2$ solution in excess of that which would have been required by the normal acid solution alone in each case, viz., 10.63 cc. They, therefore, correspond to the amount of $\text{KHC}_4\text{H}_4\text{O}_6$ dissolved in 1 cc. of each saturated solution, and when multiplied by 1.77 give the grams of $\text{KHC}_4\text{H}_4\text{O}_6$ per 100 cc. solution.

SOLUBILITY OF MONO POTASSIUM TARTRATE IN AQUEOUS SOLUTIONS OF VARIOUS
SALTS AND ACIDS AT 13° TO 15°. (Klaproth, 1922.)

The method used for securing saturation consisted (A), in dissolving 1.0 gram of $\text{KHC}_4\text{H}_4\text{O}_6$ in hot water and adding the solution to the quantity of salt or acid necessary to yield the concentration in which it was desired to determine the solubility of the tartrate. The mixture was diluted to 100 cc., shaken frequently, allowed to cool to room temperature and stand at least one day. An alternate method (B) differed from the above only in that the 1.0 gram of tartrate was added directly without previously being dissolved by warming. Thus an attempt was made to approach equilibrium from above and from below without application of continuous agitation. The results by the two methods differ so greatly that it is certain saturation was not reached. Consequently, the figures have only a qualitative interest. They show, in general, that salts with a common ion reduce the solubility and acids or salts with no common ion increase it. The solubility was found to be least in a formic acid mixture, and it was concluded that this acid could be advantageously used to precipitate mono potassium tartrate from its aqueous solutions.

POTASSIUM Acid TARTRATE

SOLUBILITY OF MONO POTASSIUM TARTRATE ($\text{KHC}_4\text{H}_4\text{O}_6$) IN AQUEOUS SOLUTIONS OF ELECTROLYTES AT 25°.

(Noyes and Clement, 1894; Magnanini, 1901.)

Electro-lyte.	Gm. Equiv. per Liter.		Gms. per Liter.		Electro-lyte.	Gm. Equiv. per Liter.		Gms. per Liter.	
	Electro-lyte.	$\text{KHC}_4\text{H}_4\text{O}_6$	Electro-lyte.	$\text{KHC}_4\text{H}_4\text{O}_6$		Electro-lyte.	$\text{KHC}_4\text{H}_4\text{O}_6$	Electro-lyte.	$\text{KHC}_4\text{H}_4\text{O}_6$
KCl	0.025	0.0254	1.86	4.788	CH_3COOK	0.05	0.0410	4.91	7.718
"	0.05	0.0196	3.73	3.680	"	0.10	0.0504	9.82	9.486
"	0.10	0.0133	7.46	2.509	"	0.20	0.0634	19.63	11.930
"	0.20	0.0087	14.92	1.636	$\text{KHSO}_4(20^\circ)$	0.01	0.0375	1.36	7.06
KClO_3	0.025	0.0256	3.06	4.821	"	0.02	0.0500	2.72	9.41
"	0.05	0.0197	6.13	3.716	"	0.10	0.1597	13.62	30.06
"	0.10	0.0138	12.26	2.601	$\text{KHC}_2\text{O}_4^*(20^\circ)$	0.01	0.0369	1.28	6.94
"	0.20	0.0097	24.52	1.728	"	0.02	0.0424	2.56	7.98
KBr	0.05	0.0192	5.95	3.699	"	0.10	0.1132	12.82	21.30
"	0.10	0.0134	11.91	2.517	HCl	0.013	0.0367	0.45	6.90
"	0.20	0.0087	23.82	1.629	"	0.025	0.0428	0.91	8.06
KI	0.05	0.0196	8.30	3.687	"	0.050	0.0589	1.82	11.09
"	0.10	0.0132	16.61	2.492	NaCl	0.05	0.0376	2.92	7.08
"	0.20	0.0086	33.22	1.619	"	0.10	0.0397	5.85	7.48
KNO_3	0.05	0.0195	5.06	3.676	"	0.20	0.0428	11.70	8.05
"	0.10	0.0136	10.12	2.551	NaClO_3	0.05	0.0382	5.32	7.18
"	0.20	0.0090	20.24	1.696	"	0.10	0.0405	10.65	7.63
K_2SO_4	0.05	0.0208	4.36	3.921	"	0.20	0.0446	21.30	8.40
"	0.10	0.0147	8.72	2.769					
"	0.20	0.0100	17.44	1.888					

* = acid potassium oxalate.

100 gms. Methyl Alcohol (CH_3OH) dissolve 0.6 gm. $\text{KHC}_4\text{H}_4\text{O}_6$ at 66°.
(b.pt.). (Henstock, 1934.)

SOLUBILITY OF MONO POTASSIUM TARTRATE IN AQUEOUS ALCOHOL AT 25°.
(Seidell, 1920.)

Wt. % $\text{C}_2\text{H}_5\text{OH}$ in Solvent.	d_{25} of Sat. Sol.	Gms. $\text{KHC}_4\text{H}_4\text{O}_6$ per 100 Gms. Sat. Sol.	Wt. % $\text{C}_2\text{H}_5\text{OH}$ in Solvent.	d_{25} of Sat. Sol.	Gms. $\text{KHC}_4\text{H}_4\text{O}_6$ per 100 Gms. Sat. Sol.
0	1.002	0.649	50	0.912	0.064
10	0.985	0.358	60	0.890	0.043
20	0.970	0.210	80	0.842	0.023
30	0.953	0.131	92.3	0.807	0.014
40	0.933	0.087	100	0.789	0.010

SOLUBILITY OF MONO POTASSIUM TARTRATE IN AQUEOUS SOLUTIONS OF ALCOHOL AT 14°.
(Pierrat, 1921.)

Saturation was obtained by agitating the mixtures for several hours. The sat. solution was evaporated to dryness in a current of air and the residue dissolved in enough water to yield the original volume of the solution. The tartrate in this was determined by electrolytic conductivity.

Wt. per cent $\text{C}_2\text{H}_5\text{OH}$ in solvent.	Gms. $\text{KHC}_4\text{H}_4\text{O}_6$ per 100 cc. sat. sol.	Wt. per cent $\text{C}_2\text{H}_5\text{OH}$ in solvent.	Gms. $\text{KHC}_4\text{H}_4\text{O}_6$ per 100 cc. sat. sol.
0.0 (= H_2O)	4.8	42.4	0.42
8.7	2.2	58.5	0.20
15.9	1.5	94.7	0.05
27.3	0.77		

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SOLUBILITY OF MONO POTASSIUM TARTRATE IN AQUEOUS SOLUTIONS OF ALCOHOL AT 18°. (Paul, 1927, 1926.).

t°.	Gms. $\text{KHC}_4\text{H}_4\text{O}_6$ per 100 cc. sat. solution in aq. $\text{C}_2\text{H}_5\text{OH}$ of		
	5.0 gms. $\text{C}_2\text{H}_5\text{OH}$ per 100 cc. ($d_{20} = 0.98650$)	8.0 gms. $\text{C}_2\text{H}_5\text{OH}$ per 100 cc. ($d_{20} = 0.98155$)	10.0 gms. $\text{C}_2\text{H}_5\text{OH}$ per 100 cc. ($d_{20} = 0.97513$)
0....	0.1746 (0.98998)	0.1375 (0.98247)	0.1248 (0.97805)
10....	0.2605 (0.98974)	0.2078 (0.98203)	0.1905 (0.97746)
18....	0.358	0.294	0.258
20....	0.3924 (0.98876)	0.3371 (0.98170)	0.3003 (0.97678)
25....	0.4747 (0.98785)	0.4045 (0.98141)	0.3662 (0.97546)
30....	0.5846 (0.98673)	0.4965 (0.98118)	0.4323 (0.97364)

The figures in parentheses show the d_{20}^4 of the saturated solutions.

The author also gives data for the p_H and the electrolytic conductivity of the saturated solutions.

POTASSIUM Acid TARTRATE $\text{KHC}_4\text{H}_4\text{O}_6$

SOLUBILITY OF MONO POTASSIUM TARTRATE IN AQUEOUS SOLUTIONS OF INVERT SUGAR (GLUCOSE + FRUCTOSE) AT 20°. (Richert, 1930.)

C_4H

Percent Invert sugar by weight	Gm. Mols. $\text{KHC}_4\text{H}_4\text{O}_6$ per:	
	1000cc sat. solution	1000. gms. sat. sol.
0	0.0284	0.0284
15	0.0276	0.0260
30	0.0264	0.0232
45	0.0240	0.0198
60	0.0200	0.0155
80	0.0124	0.0087

SOLUBILITY OF MONO POTASSIUM TARTRATE IN AQUEOUS SOLUTIONS OF SEVERAL SUGARS AT 20°. (Carpenter and Kucera, 1934.)

Wt. Percent Sugar	Gms. $\text{KHC}_4\text{H}_4\text{O}_6$ per 100 gms. sat. solution in aqueous:			
	d Glucose Solution	d Fructose Solution	Invert Sugar Solution	Sucrose Solution
0	0.5323 (1.0012)	0.5323 (1.0012)	0.5323 (1.0012)	0.5323 (1.0012)
5	—	0.5180 (1.0210)	0.5171 (1.0209)	—
10	0.4924 (1.0405)	0.5037 (1.0414)	0.4979 (1.0411)	0.4715 (1.0409)
20	0.4442 (1.0824)	0.4637 (1.0843)	0.4570 (1.0837)	0.4237 (1.0835)
30	0.4010 (1.1272)	0.4269 (1.1303)	0.4152 (1.1296)	0.3707 (1.1293)
40	—	0.3833 (1.1796)	0.3700 (1.1788)	0.3114 (1.1784)

The figures in parentheses are densities of the saturated solutions. The authors also give similar results for the temperatures 0°, 5°, 10° and 15°.

POTASSIUM TARTRATE ($\text{K}_2\text{C}_4\text{H}_4\text{O}_6$) $\cdot\text{H}_2\text{O}$.

100 gms. H_2O dissolve 138 gms. $\text{K}_2\text{C}_4\text{H}_4\text{O}_6$ at 16.6°, Sp. Gr. of sat. sol. = 1.49. (Greenish and Smith, 1901.)

POTASSIUM Sodium TARTRATE, $\text{KNaC}_4\text{H}_4\text{O}_6 \cdot 3\text{H}_2\text{O}$ and $\cdot 4\text{H}_2\text{O}$ *r* and *d*.

SOLUBILITY OF THE POTASSIUM SODIUM SALT OF DEXTRO AND OF RACEMIC TARTRIC ACIDS IN WATER. (Brönsted, 1921, 1926.)

Salt of Racemic Acid.		Salt of Dextro Acid.				Salt of Mixture of <i>d</i> and <i>l</i> Acids.	
t° of Cryst.	Gms. $\text{KNaC}_4\text{H}_4\text{O}_6$ per 100 gms. H_2O .	t° of Cryst.	Gms. $\text{KNaC}_4\text{H}_4\text{O}_6$ per 100 gms. H_2O .	t° of Cryst.	Gms. $\text{KNaC}_4\text{H}_4\text{O}_6$ per 100 gms. H_2O .	t° of Cryst.	Gms. $\text{KNaC}_4\text{H}_4\text{O}_6$ per 100 gms. H_2O .
-6.98...	42.7	-4.7.....	28.7	0.0...	32.0	-6.42...	39.3
-5.95...	36.5	-4.34....	26.0	9.7...	46.1	+9.7....	64.4
+9.7....	58.0	-3.38....	19.0	18.0...	62.9	29.5....	140.5
29.5....	92.3	-1.875...	10.2	29.5...	100.7		

EQUILIBRIUM IN THE SYSTEM POTASSIUM SODIUM TARTRATE SODIUM HYDROXIDE AND WATER AT 25°.

(Campbell and Campbell, 1932.)

Gms. per 100 gms. sat. sol.		Gms. per 100 gms. sat. sol.	
$\text{KNaC}_4\text{H}_4\text{O}_6$	NaOH	$\text{KNaC}_4\text{H}_4\text{O}_6$	NaOH
39.0	0.0	22.6	12.2
33.3	3.7	16.1	13.85
31.0	5.8	21.6	15.3
29.0	7.3	35.2	24.8
29.5	7.6	25.7	23.9
20.2	13.5		

The three sections of the solubility curve are considered to correspond respectively to hydrated Rochelle Salts, anhydrous Rochelle Salts and a solid complex which resembles a stiff gel.

C_4H

POTASSIUM Sodium TARTRATE. $\text{KNaC}_4\text{H}_4\text{O}_6 \cdot 4\text{H}_2\text{O}$. (Rochelle or Seignette Salt.)

100 gms. sat. aq. solution contain 36.66 gms. $\text{KNaC}_4\text{H}_4\text{O}_6$ at 9.7° and 47.97 gms. at 29.5°.

(van't Hoff and Goldschmidt, 1895.)

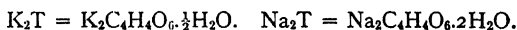
100 gms. H_2O dissolve 53.53 gms. $\text{KNaC}_4\text{H}_4\text{O}_6$ at 15°, Sp. Gr. of sol. = 1.2713.

(Greenish & Smith, 1901.)

SOLUBILITY OF MIXTURES OF POTASSIUM TARTRATE AND OF SODIUM TARTRATE IN WATER AT SEVERAL TEMPERATURES.

(van Leeuwen, 1897.)

t°.	Gms. per 100 $\text{K}_2\text{C}_4\text{H}_4\text{O}_6$	Gms. Sat. Sol. $\text{Na}_2\text{C}_4\text{H}_4\text{O}_6$	Solid Phase.	t°.	Gms. per 100 $\text{K}_2\text{C}_4\text{H}_4\text{O}_6$	Gms. Sat. Sol. $\text{Na}_2\text{C}_4\text{H}_4\text{O}_6$	Solid Phase.
18	19.2	16.5	$\text{KNaC}_4\text{H}_4\text{O}_6 \cdot 4\text{H}_2\text{O}$	26.6	56	4.2	$\text{KNaC}_4\text{H}_4\text{O}_6 \cdot 4\text{H}_2\text{O} + \text{K}_2\text{T}$
38	26.6	22.8	"	48.3	51.6	13.2	"
20.9	11.8	28	" + Na_2T	59.7	44.5	25.3	$\text{K}_2\text{T} + \text{Na}_2\text{T}$
38	25.8	24.7	"	80	39.7	34.7	"
50	36.7	23.9	"				



SOLUBILITY OF SEVERAL POTASSIUM SALTS OF TARTARIC ACIDS IN WATER AT 20°.

(Schlossberg, 1900.)

Salt.	Formula.	Gms. Salt per 100 Gms. Sat. Sol.
Potassium Sodium Salt of Racemic Acid	$\text{KNa}(\text{C}_4\text{H}_4\text{O}_6) \cdot 3\text{H}_2\text{O}$	62.84
Potassium Sodium Salt of <i>d</i> Tartaric Acid	$\text{KNa}(\text{C}_4\text{H}_4\text{O}_6) \cdot 4\text{H}_2\text{O}$	63.50
Potassium Neutral Inactive Pyrotartrate	$\text{K}_2\text{C}_6\text{H}_6\text{O}_6 \cdot \text{H}_2\text{O}$	56.33
Potassium Neutral Dextropyrotartrate	$\text{K}_2\text{C}_6\text{H}_6\text{O}_6$	57.62

SOLUBILITY OF POTASSIUM SODIUM TARTRATE IN AQ. ALCOHOL SOLUTIONS AT 25°.
(Seidell, 1910.)

Wt. % C ₂ H ₅ OH in Solvent.	d ₂₅ of Sat. Sol.	Gms. KNaC ₄ H ₄ O ₆ ·4H ₂ O per 100 Gms. Solvent.	Wt. % C ₂ H ₅ OH in Solvent.	d ₂₅ of Sat. Sol.	Gms. KNaC ₄ H ₄ O ₆ ·4H ₂ O per 100 Gms. Sol.
0	1.310	53.33	50	0.908	2.40
10	1.216	41.60	60	0.878	0.90
20	1.124	26.20	70	0.857	0.30
30	1.034	13.80	80	0.840	0.06
40	0.961	6	100	0.789	trace

POTASSIUM DihydroxyTARTRATES K₂C₄H₄O₆·H₂O and KHC₄H₄O₆·H₂O.

100 gms. H₂O dissolve 2.66 gms. K₂C₄H₄O₆·H₂O at 0°. (Fenton, 1898.)

100 gms. H₂O dissolve 2.70 gms. KHC₄H₄O₆·H₂O at 0°. "

F.-pt. data for mixtures of *d* and *l* dimethyl ester of potassium bitartrate and for mixtures of *d* and *l* diacetyl dimethylester of potassium bitartrate are given by Adriani (1900).

POTASSIUM Antimony TARTRATE C₂H₂(OH)₂(COOK)(COOSbO).½H₂O.

100 gms. water dissolve 5.9 gms. salt at room temp. (Squire and Caines, 1905.)

" " " 6.9 " " " 25°. (S and S, 1903.)

" " " 8 " " " 21°. (Aschan, 1913.)

" 95% HCOOH dissolve 82.7 gms. salt at 20.8°. (Aschan, 1913.)

" glycerol dissolve 5.5 gms. salt at 15.5°.

SOLUBILITY OF ANTIMONY POTASSIUM TARTRATE IN AQ. ALCOHOL
SOLUTIONS AT 25°.

(Seidell, 1910.)

Wt. Per cent C ₂ H ₅ OH in Solvent.	d ₂₅ of Sat. Sol.	Gms. C ₂ H ₄ O ₆ . KSbO.½H ₂ O per 100 Gms. Sat. Sol	Wt. Per cent C ₂ H ₅ OH in Solvent.	d ₂₅ of Sat. Sol.	Gms. C ₂ H ₄ O ₆ . KSbO.½H ₂ O per 100 Gms. Sat. Sol.
0	1.052	7.85	40	0.935	0.38
5	1.025	5.50	50	0.913	0.23
10	1.007	3.92	60	0.890	0.12
20	0.980	1.92	70	0.866	0.06
30	0.958	0.84	100	0.788	trace

POTASSIUM SUCCINATE K₂C₄H₄O₄·3H₂O

100 gms. Methyl Alcohol (CH₃OH) sat. with anhydrous potassium succinate dissolve 3.16 gms. K₂C₄H₄O₄ at 15° and 3.75 gms. at 66.6 (b.pt.). (Hlenstock, 1934.)

POTASSIUM URATE. KHC₅H₂N₄O₃

SOLUBILITY OF POTASSIUM URATE IN WATER. (Barkan, 1924.)

It was previously shown that sodium urate passes from a gelatin like colloidal form to a stable granular condition, and the author desired to learn if the potassium salt behaves likewise. Several different samples of potassium urate were prepared and used for solubility determinations. The solubility of each diminished with time of rotation. In general the diminution was from about 2.38 gms. per liter to 1.9 gms. per liter. The mean of all the determinations was :

2.13 gms. (= 10.35 × 10⁻³ gms. mols.) potassium urate per liter at 18°.

Several determinations of the solubility of the compound in the fresh colloidal form gave, as the highest value, 6.67 gms. (= 32.4.10⁻³ gm. mols.) potassium urate per liter at 18°.

POTASSIUM CITRATE $(\text{CH}_2)_2\text{C}(\text{OH})(\text{COOK})_3 \cdot \text{H}_2\text{O}$.**SOLUBILITY IN WATER.**

(Average results of Seidell, 1910; Greenish and Smith, 1901; Köhler, 1897.)

t°.	Gms. $(\text{CH}_2)_2\text{C}(\text{OH})(\text{COOK})_3 \cdot \text{H}_2\text{O}$ per 100 Gms.	
	Sat. Solution.	Water.
15	61.8	162
20	63.2	172
25	64.5	182 ($d_{25} = 1.518$)
30	66	194

100 gms. H_2O dissolve 198.3 gms. $(\text{CH}_2)_2\text{COH}(\text{COOK})_3 + 303.9$ gms. cane sugar at 31.25° . (Köhler, 1897.)

SOLUBILITY OF POTASSIUM CITRATE IN AQUEOUS ETHYL ALCOHOL AT 25° .
(Seidell, 1910.)

When potassium citrate is added to aqueous alcohol of certain concentrations the mixture separates into two liquid layers. A series of determinations made by adding an excess of the salt to 10–15 cc. portions of several aq. alcohol mixtures at 25° gave the following results.

Wt. % $\text{C}_2\text{H}_5\text{OH}$ in Solvent.	d_{25} of Sat. Solution.	Wt. % $\text{C}_2\text{H}_5\text{OH}$ in Sat. Solution.	Gms. $(\text{CH}_2)_2\text{COH}-$ $(\text{COOK})_3 \cdot \text{H}_2\text{O}$ per 100 Gms. Sat. Solution.
8.9	{ <i>a</i> ... <i>b</i> 1.4920	...	...
32	{ <i>a</i> ... <i>b</i> 1.4930	...	0.2
51	{ <i>a</i> ... <i>b</i> ...	65.1	0.38
70.2	{ <i>a</i> 0.8366 <i>b</i> ...	81	0.10
81.4	0.8356	81.4	0.038
91.6	0.8139	91.6	0.016
99.9	0.7896	99.5	0.014

 C_5H

a = upper, alcohol rich layer. *b* = lower, water rich layer.

A series of determinations was also made by adding just enough potassium citrate to the alcohol solution to cause distinct clouding and then, after bringing to 25° , titrating with the aqueous alcohol mixture to disappearance of the clouding. The results were plotted and the following interpolated values obtained.

Wt. % $\text{C}_2\text{H}_5\text{OH}$ in Solvent.	d_{25} of Sat. Solution.	Gms. $(\text{CH}_2)_2\text{COH}-$ $(\text{COOK})_3 \cdot \text{H}_2\text{O}$ per 100 Gms. Sat. Sol.	Wt. % $\text{C}_2\text{H}_5\text{OH}$ in Solvent.	d_{25} of Sat. Solution.	Gms. $(\text{CH}_2)_2\text{COH}-$ $(\text{COOK})_3 \cdot \text{H}_2\text{O}$ per 100 Gms. Sat. Sol.
0	1.518	64.5	40	1.005	12.4
5	1.400	52.5	50	0.943	5.6
10	1.310	45.5	60	0.900	1.6
20	1.177	31.5	70	0.868	0.4
30	1.085	21.5	80	0.838	0.04

In one determination at 15° , made with alcohol of 59 Vol. per cent, 4.51 gms. $(\text{CH}_2)_2\text{COH}(\text{COOK})_3 \cdot \text{H}_2\text{O}$ were required to just cause clouding.

100 gms. U.S.P. Glycerol $(\text{CH}_2\text{OHCH(OH)CH}_2\text{OH})$ saturated with Potassium Citrate contain 28.2 gms. $(\text{CH}_2)_2\text{C}(\text{OH})(\text{COOK})_3 \cdot \text{H}_2\text{O}$ at 25° . (Schnellbach and Rosin, 1931.)

POTASSIUM PHENOLATES, $C_6H_5OK \cdot 2H_2O$, $C_6H_5OK \cdot 3C_6H_5OH$.
EQUILIBRIUM IN THE SYSTEM POTASSIUM HYDROXIDE, PHENOL AND WATER AT 25°.
 (Van Meurs, 1916.)

Mols. per 100 mols. sat. sol.		Solid Phase.	Mols. per 100 mols. sat. sol.		Solid Phase.
C_6H_5OH .	KOH.		C_6H_5OH .	KOH.	
70.20	0.74	C_6H_5OH	25.93	17.15	$C_6H_5OK \cdot 2H_2O$
76.40	4.13	"	22.15	16.92	"
60.16	7.28	$C_6H_5OK \cdot 3C_6H_5OH$	14.95	15.48	"
51.27	8.32	"	8.84	15.39	"
46.38	9.11	"	5.57	15.14	"
33.79	11.18	"	0.92	16.04	"
29.70	17.13	"	0.04	26.04	"
31.69	19.05	$\gg C_6H_5OK \cdot 2H_2O$	0.0	27.65	$KOH \cdot 2H_2O$

The two liquid layers which are formed at concentrations of KOH less than about 0.5 mol. % have the following compositions.

Aqueous layer.		Phenol layer.	
Mol. % C_6H_5OH .	Mol. % KOH.	Mol. % C_6H_5OH .	Mol. % KOH.
1.79	0.0	32.33	0.0
2.48	0.19	21.60	0.37
3.85	0.25	15.85	0.45

POTASSIUM PICRATE $C_6H_2(NO_2)_3OK$.

C_6H 1000 cc. sat. solution of potassium picrate in water contain 5.06 gms. $C_6H_2(NO_2)_3OK$ at 20°. (Moser and Ritschel, 1925.)

SOLUBILITY OF POTASSIUM PICRATE IN AQUEOUS SOLUTIONS OF ETHYL ALCOHOL, METHYL ALCOHOL AND OF ACETONE AT 25°. (Fischer, 1914, 1918.)

The composition of the aqueous alcohol and acetone mixtures, which served as solvents, was accurately controlled by density determinations. Saturation was secured by constant agitation in a thermostat. The saturated solution was withdrawn by means of a graduated pipet and its dissolved picrate determined by evaporation and weighing the residuc, or by a method of titration. The absolute alcohol was prepared by treatment with lime and distillation.

Vol. per cent C_6H_5OH in solvent.	Gms. $C_6H_2(NO_2)_3OK$ per 100 cc. sat. sol.	Vol. per cent C_6H_5OH in solvent.	Gms. $C_6H_2(NO_2)_3OK$ per 100 cc. sat. sol.	Vol. % CH_3OH in solvent.	Gms. $C_6H_2(NO_2)_3OK$ per 100 cc. sat. sol.	Vol. % Acetone in solvent.	Gms. $C_6H_2(NO_2)_3OK$ per 100 cc. sat. sol.
0.0 ($=H_2O$)	0.645	55	0.598	10	0.542	10	0.726
10	0.559	60	0.574	20	0.470	20	0.876
15	0.475	65	0.546	30	0.444	30	1.140
20	0.450	70	0.485	40	0.422	40	1.155
25	0.453	75	0.410	50	0.411	50	2.106
30	0.472	80	0.326	60	0.410	60	2.615
35	0.484	85	0.227	70	0.396	70	3.090
40	0.533	90	0.174	80	0.332	80	3.340
45	0.560	95	0.100	90	0.254	90	3.084
50	0.582	100	0.184 (?)	100	0.274	100	1.080

Data for the solubility of potassium picrate in aqueous solutions of ethyl alcohol, methyl alcohol and of acetone at 25° are given by Fisher, 1914.

POTASSIUM RESORCINOLATES $C_6H_2(OH)(OK) \cdot H_2O$, $C_6H_2(OK)_2 \cdot 3H_2O$.EQUILIBRIUM IN THE SYSTEM POTASSIUM HYDROXIDE, RESORCINOL AND WATER
AT 30°. (Van Meurs, 1916.)

Mols. per 100 mols. sat. sol.			Mols. per 100 mols. sat. sol.		
$C_6H_2(OH)_2$, m.	KOH	Solid Phase	$C_6H_2(OH)_2$, mg.	KOH	Solid Phase
38.84	0.0	$C_6H_2(OH)_2$, m.	16.44	16.07	$C_6H_2(OK)_2 \cdot 3H_2O$
46.86	4.96	"	14.58	16.44	"
57.30	6.84	"	6.68	17.74	"
69.06	10.14	"	1.44	22.74	"
80.22	16.95	$C_6H_2(OH)(OK) \cdot H_2O$	0.74	26.49	"
86.84	16.40	"	0.76	26.99	" + KOH
34.00	16.64	"	0.74	29.94	" "
36.74	17.64	"	0.74	30.44	KOH
35.64	17.84	" + $C_6H_2(OK)_2 \cdot 3H_2O$	0.44	39.88	KOH H_2O
22.40	17.44	$C_6H_2(OK)_2 \cdot 3H_2O$	0.12	39.70	"
18.99	16.64	"	0.0	38.80	KOH H_2O

POTASSIUM GLUCONATE $KC_6H_{11}O_7$.100 cc. sat. solution of Potassium gluconate in water contain 50.85 gms. $KC_6H_{11}O_7$ at 25°. (May, Weinberg and Herrick, 1929.)**POTASSIUM BENZOATE** $KC_6H_5O_2 \cdot 3H_2O$.

SOLUBILITY IN WATER.

(Paglia, 1906, 1907.)

t°.	17.5°	25°	33.3°	50°
Gms. $KC_6H_5O_2$ per 100 Gms. Solution	41.1	42.4	44	46.6

POTASSIUM BENZOATE C_6H_5COOK .

SOLUBILITY OF POTASSIUM BENZOATE IN WATER.

(Sedgwick and Lushbank, 1922.)

t°	Gms. C_6H_5COOK per 100 gms. sat. sol.	Solid Phase	t°	Gms. C_6H_5COOK per 100 gms. sat. sol.	Solid Phase
-10.80	5.04	Ice	44.00	44.94	C_6H_5COOK
-2.14	9.20	"	81.00	50.99	"
3.09	16.24	"	97.00	54.50	"
7.34	24.54	"	144.00	58.49	"
10.5	49.89	C_6H_5COOK	181.0	65.09	"
14.0	40.60	"			

100 gms. Methyl Alcohol (CH_3OH) dissolve 7.07 gms. C_6H_5COOK at 15° and 8.44 gms. at 60° (b.p.). (Penstock, 1944.)**POTASSIUM HYDROXY BENZOATES** *o*, *m* and *p* $C_6H_4(OH)COOK$.SOLUBILITY OF POTASSIUM *Ortho* HYDROXY BENZOATE (= POTASSIUM SALICYLATE) IN WATER.

(Sedgwick and Lushbank, 1922.)

t°	Gms. $C_6H_4(OH)COOK$ per 100 gms. sat. sol.	Solid Phase	t°	Gms. $C_6H_4(OH)COOK$ per 100 gms. sat. sol.	Solid Phase
1.82	10.49	Ice	24.0	54.44	$C_6H_4(OH)COOK \cdot H_2O$
4.47	18.84	"	28.5	54.89	"
6.52	41.14	"	61.0	64.44	$C_6H_4(OH)COOK$
8.0	45.80	"	104.8	68.47	"
9	46.08	$C_6H_4(OH)COOK \cdot H_2O$	108.5	70.00	"
9	49.49	"	148.2	74.00	"

SOLUBILITY OF POTASSIUM
Meta Hydroxy Benzoate in Water.

t ₃	Gms. C ₆ H ₄ OH.COOK(m) per 100 gms. sat. sol.	Solid Phase.
— 2.41...	12.39	Ice
— 5.06...	22.25	"
— 8.59...	31.34	"
— 19.92...	49.39	"
+ 10.0....	59.04	C ₆ H ₄ OH.COOK(m)
33.5....	61.94	"
95.0....	69.60	"
136.8....	75.02	"

SOLUBILITY OF POTASSIUM
Para Hydroxy Benzoate in Water.

t°	Gms. C ₆ H ₄ OH.COOK(p) per 100 gms. sat. sol.	Solid Phase.
— 1.43...	8.04	Ice
— 3.24...	15.55	"
+ 15.8....	29.91	(p)C ₆ H ₄ OH.COOK.3H ₂ O
	25.8....	35.50
	43.0....	45.71
	64.4. .	56.70
	70.5....	59.34
	86.8....	63.01
	129.5....	64.95
		(p) C ₆ H ₄ OH.COOK

POTASSIUM MANDELATE (Racemic) C₆H₅.CHOH.COOK

EQUILIBRIUM IN THE SYSTEM RACEMIC POTASSIUM MANDELATE,
RACEMIC MANDELIC ACID AND WATER AT 25°.

(Ross and Morrison, 1933.)

	Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase
	C ₆ H ₅ O ₃	C ₆ H ₇ O ₃ K		C ₆ H ₅ O ₃	C ₆ H ₇ O ₃ K	
C ₈ H	3.3	47.3	[K(C ₆ H ₇ O ₃) ₂]H	12.9	13.7	[K(C ₆ H ₇ O ₃) ₄]H ₃
	4.1	45.2	"	14.4	12.3	"
	5.1	37.2	"	15.8	11.2	"
	6.4	33.3	"	20.4	9.8	"
	7.7	30.8	"	24.0	9.4	"
	8.1	29.7	[K(C ₆ H ₇ O ₃) ₃]H ₂	27.1	8.8	"
	6.3	27.7	"	30.1	8.5	"
	5.5	24.7	"	31.7	8.3	C ₈ H ₈ O ₃
	6.0	23.1	"	30.1	7.7	"
	6.5	19.5	"	27.1	6.7	"
	8.6	16.2	"	25.0	5.5	"
	11.4	14.5	"	21.6	3.8	"
	8.4	16.5	"	18.6	1.1	"
	11.0	15.6	[K(C ₆ H ₇ O ₃) ₄]H ₃	16.9	0.0	"
	11.6	15.0				

POTASSIUM MANDELATE (Laevo) C₆H₅.CHOH.COOK

EQUILIBRIUM IN THE SYSTEM (-) POTASSIUM MANDELATE

(-) MANDELIC ACID AND WATER AT 25°.

(Rosa, Morrison and Johnstone, 1937.)

	Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase
	C ₆ H ₅ O ₃	C ₆ H ₇ O ₃ K		C ₆ H ₅ O ₃	C ₆ H ₇ O ₃ K	
	9.7	46.4	[K(C ₆ H ₇ O ₃) ₂]H	30.9	17.7	C ₈ H ₈ O ₃
	34.4	38.5	"	12.1	6.0	"
	42.7	37.3	"	10.5	3.2	"
	39.8	27.2	" + C ₈ H ₈ O ₃	10.1	1.4	"
				10.1	0.0	"

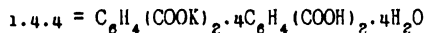
POTASSIUM PHTHALATE $C_6H_4(COOK)_2$

EQUILIBRIUM IN THE SYSTEM POTASSIUM PHTHALATE, PHTHALIC ACID AND WATER AT SEVERAL TEMPERATURES.

(Smith, 1931.)

Gms. per 100 gms. sat. sol.		Solid Phase
$C_6H_4(COOH)_2$	$C_6H_4(COOK)_2$	
Results at 0°		
0.0	60.4	$C_6H_4(COOK)_2$
0.10	60.4	" + $C_6H_4(COOH)(COOK)$
0.11	48.89	$C_6H_4(COOH)COOK$
0.19	33.02	"
0.40	20.43	"
1.06	8.33	"
2.01	4.01	" + 1.4.4
1.74	2.79	1.4.4
1.55	2.12	" + $C_6H_4(COOH)_2$
0.89	1.00	$C_6H_4(COOH)_2$
0.30	—	
Results at 25°		
0.0	74.8	$C_6H_4(COOK)_2$
0.17	74.7	" + $C_6H_4(COOH)COOK$
0.27	60.97	$C_6H_4(COOH)COOK$
0.28	48.16	"
0.36	39.70	"
0.54	31.23	"
0.77	23.33	"
1.25	16.65	"
3.07	7.10	"
4.16	6.11	" + 1.4.4
3.93	5.41	1.4.4
3.77	4.80	" + $C_6H_4(COOH)_2$
3.44	4.12	$C_6H_4(COOH)_2$
2.61	2.87	"
1.72	1.47	"
0.75	0.0	"

Gms. per 100 gms. sat. sol.		Solid Phase
$C_6H_4(COOH)_2$	$C_6H_4(COOK)_2$	
Results at 35°		
0.0	78.5	$C_6H_4(COOK)_2$
0.28	75.6	" + $C_6H_4(COOH)COOK$
0.27	68.51	$C_6H_4(COOH)COOK$
0.33	58.59	"
0.38	48.67	"
0.51	37.43	"
0.89	27.07	"
1.28	21.03	"
2.32	13.09	"
3.23	9.76	"
5.10	7.43	"
5.70	7.32	" + 1.1.4
5.53	6.64	1.1.4 + $C_6H_4(COOH)_2$
5.29	6.35	$C_6H_4(COOH)_2$
4.74	5.60	"
2.38	2.06	"
0.98	0.0	"
Results at 60°		
0.0	78.9	$C_6H_4(COOK)_2$
0.40	79.0	" + $C_6H_4(COOH)COOK$
0.51	64.17	$C_6H_4(COOH)COOK$
0.80	49.07	"
2.15	29.66	"
4.94	16.57	"
8.50	12.59	"
14.14	13.00	" + $C_6H_4(COOH)_2$
7.68	5.97	$C_6H_4(COOH)_2$
2.58	0.00	"



The transition temperature above which this 1.4.4 double salt does not exist was found to be 36.68° and the composition of the saturated solution at this temperature was 6.14 percent $C_6H_4(COOH)_2$ and 7.65 percent $C_6H_4(COOK)_2$.

POTASSIUM Hydrogen PHTHALATE $KHC_8H_4O_8$.

100 gms. sat. solution of potassium hydrogen phthalate in water contain 10.23 gms. $KHC_8H_4O_8$ at 25° , 12.67 gms. at 35° and 36.12 gms. at the b. pt.

(Hendrixson, 1920.)

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SOLUBILITY OF POTASSIUM PHTHALATE IN ALCOHOLS AT 20°.

(Handy and Hoyt, 1977.)

Solvent	Gms. $C_6H_5(COOK)_2$ per 100 cc solvent
Ethyl Alcohol (absolute)	0.0161
" " (95%)	0.0252
100 vols. " " " + 10 Vols. CH_3OH	0.0728
Methyl Alcohol (CH_3OH)	0.792

POTASSIUM PHENYL ACETATE $CH_2C_6H_5COOK$

Fusion-point data for mixtures of Potassium Phenyl acetate and Phenyl acetic acid, showing the formation of the compound $CH_2C_6H_5COOK$. $CH_2C_6H_5COOH$ are given by Bakunin and Vitale, 1935.

POTASSIUM Benzene SULFONATES

SOLUBILITY OF EACH SEPARATELY IN WATER AT 25°.

(Elgersma, 1929.)

Compound	Formula	Gms. anhydrous compound per 100 gms. H_2O
Potassium $\frac{0}{m}$ Nitro benzene sulfonate	$K[NO_2 \cdot C_6H_4 \cdot SO_3]$	9.63
" $\frac{1}{p}$ " " " "	" "	3.04
" $\frac{0}{p}$ Dinitro " " " "	$K(NO_2)_2 \cdot C_6H_3 \cdot SO_3$	5.95
" $\frac{2}{2}$ Nitro 4 Chlor " " "	$KNO_2 \cdot C_6H_3ClSO_3$	4.70
" $\frac{2}{2}$ " 5 " " " "	" "	0.87
" $\frac{3}{2}$ " 6 " " " "	" "	1.59
" $\frac{3}{2}$ " 6 " " " "	" "	2.83
" $\frac{2}{2}$ " 4 Brom " " "	$K[NO_2 \cdot C_6H_3Br \cdot SO_3]$	1.68

100 gms. sat. solution of Potassium $\frac{m}{m}$ chloro benzene Sulfonate in water contain 3.12 gms. $\frac{m}{m}$ $C_6H_4ClSO_3K$ at 18° and approximately 45.0 gms. at 98°.

100 gms. sat. solution of Potassium $\frac{p}{p}$ chloro benzene sulfonate in water contain 0.73 gm. $\frac{p}{p}$ $C_6H_4ClSO_3K$ at 18° and approximately 40.0 gms. at 98°.
(Bollinger, 1928.)

100 gms. Methyl Alcohol sat. with Potassium Benzene Sulfonate contain 2.67 gms. $C_6H_5SO_3K$ at 15° and 9.67 gms. at 66.1 (b.pt.). (Henstock, 1934.)

100 gms. acetone dissolve 0.12 gm. $C_6H_5SO_3K$ at 15°. (Henstock, 1934.)

POTASSIUM Anthraquinone SULFONATES

SOLUBILITY OF EACH SEPARATELY IN WATER.

(Fierz-David, Krebsen and Anderau, 1927.)

Compound	Formula	t°	Gms. Cmpd. per 100 cc H_2O
Potassium Anthraquinone 1.5 Disulfonate	$K_2C_{14}H_6O_2(SO_3)_2$	18	0.7
" " " " "	" "	100	3.5
" " " " "	$K_2C_{14}H_6O_2(SO_3)_2 \cdot 2H_2O$	18	0.65
" " " " "	" "	100	2.2
" " " " "	$K_2C_{14}H_6O_2(SO_3)_2 \cdot 1\frac{1}{2}H_2O$	18	1.5
" " " " "	" "	100	14.3
" " " " "	$K_2C_{14}H_6O_2(SO_3)_2 \cdot 2H_2O$	18	4.3
" " " " "	" "	100	50.0
" " " " Chloro Sulfonate	$KC_{14}H_6O_2ClSO_3 \cdot 2H_2O$	18	0.4
" " " " "	$KC_{14}H_6O_2ClSO_3 \cdot 2H_2O$	18	0.42
" " " " "	" "	100	5.50
" " " " "	$KC_{14}H_6O_2ClSO_3$	18	0.17
" " " " "	$KC_{14}H_6O_2ClSO_3 \cdot 1\frac{1}{2}H_2O$	13	2.0

POTASSIUM Naphthylamine DiSULFONATES, 2.6.8 and 2.5.7 $C_{10}H_5$.
 $(NH_2)(SO_3K)_2$.

POTASSIUM Acid Naphthylamine Di SULFONATES, 2.6.8 and 2.5.7
 $C_{10}H_5(NH_2)(SO_3K)(SO_3H)$.

SOLUBILITY OF EACH SEPARATELY IN WATER AT 15°. (Braunschweig, 1922.)

Compound.		Gms. anhyd. per 100 gms. sat. sol.
2.6.8	Potassium naphthylamine Disulfonate.....	51.6
2.5.7	" " " "	63.9
2.6.8 Acid	" " " "	2.47
2.5.7	" " " "	2.58

POTASSIUM SULFONATES

SOLUBILITY OF EACH SEPARATELY IN WATER.

Compound		Gms. Anhydrous 1° Cmpd. per 100 Gms. H_2O	Authority
Potassium:			
Naphthalene Monosulfonate. $\frac{1}{2}H_2O$	25	8.48* (Witt, 1915.)	
" -2- Sulfonate	16.5	8.12 (Ephraim & Pfister, 1925.)	
" 1.4 Chloro Sulfonate	18	0.73 (Ferrero and Bolliger, 1928.)	
" 1.5 " " "	18	3.12 " " " "	
Naphthylamine 2.4.7 Sulfonate	20	29.3 (Frisch, 1930.)	
" " " "	80	66.3 " "	$C_{10}H$
2 Phenanthrene Monosulfonate. $\frac{1}{2}H_2O$	20	0.273 (Sandquist, 1912.)	
3 " " " $.01H_2O$	20	0.342 " "	
10 " " " $.1H_2O$	20	0.84 " "	
" 10 Chloro 3 or 6 Sulfonate	20	0.248 " 1917	
9 Guaiacol Sulfonate (Thiocol)	15-20	16.6 (Squire & Caines, 1905.)	
$d_{20}^{20} = 1.029$			
100cc. 90vol.% alcohol dissolve 0.25 gm. thiocol at 15-20°. (Squire & Caines, 1905.)			

POTASSIUM Cymene SULFONATE $KCH_3C_6H_4CH_2CH_2CH_2SO_3$

SOLUBILITY OF POTASSIUM CYMENE SULFONATE IN WATER.
 (Hauslick, 1935.)

1°	Gm. Mols. Sulfonate per 100 gms. H_2O	1°	Gm. Mols. Sulfonate per 100 gms. H_2O
2.5	0.025	45	0.250
15.0	0.056	68	0.523
31.0	0.133	90	0.994

POTASSIUM CAMPHORATESSOLUBILITY IN AQUEOUS SOLUTIONS OF *d* CAMPHORIC ACID AT 13.5-16° AND VICE VERSA.

(Jungfleisch and Landrieu, 1914.)

Gms. per 100	Gms. Sat. Sol.	Solid Phase.	Gms. per 100	Gms. Sat. Sol.	Solid Phase.
$C_{10}H_{16}(COOH)_2$.	$C_{10}H_{14}O_4K_2$.		$C_{10}H_{16}(COOH)_2$.	$C_{10}H_{14}O_4K_2$.	
0	66.65	$C_{10}H_{14}O_4K_2$	2.90	32.84	$C_{10}H_{14}O_4K_2 \cdot C_{10}H_{16}O_4$
0.90	69.69	$C_{10}H_{14}O_4K$	3.20	29.39	"
1	69	"	3.30	28.56	$C_{10}H_{14}O_4K_{1.3}C_{10}H_{16}O_4$
1.10	66.79	"	3.20	27.32	"
0.90	66.65	$C_{10}H_{14}O_4K \cdot H_2O$	3.20	22.77	"
1.50	62.37	"	3.10	21.66	"
2.60	59.34	"	2.90	12.97	"
3.20	58.37	"	2.90	11.73	"
3.20	58.09	"	3.10	11.59	$dC_{10}H_{16}(COOH)_2$
3.20	52.71	$C_{10}H_{14}O_4K \cdot C_{10}H_{16}O_4$	2.90	9.66	"
3.20	48.43	"	2.80	8.14	"
2.80	47.88	"	2.50	6.76	"
2.80	42.36	"	2.30	6.07	"
3	35.60	"	2	4.55	"
2.85	34.77	"	0.621	0	"

$C_{10}H_{14}O_4K_2$ = Dipotassium *d* camphorate. $C_{10}H_{14}O_4K \cdot C_{10}H_{16}O_4$ = Monopotassium *d* dicamphorate.
 $C_{10}H_{14}O_4K$ = Monopotassium *d*-camphorate. $C_{10}H_{14}O_4K_{1.3}C_{10}H_{16}O_4$ = Monopotassium *d* tetracamphorate.

POTASSIUM HELIANTHATE $KC_{14}H_{14}N_3SO_3 \cdot 2H_2O$.1000 cc. H_2O dissolve 4.368 gms. $KC_{14}H_{14}N_3SO_3 \cdot 2H_2O$ at 20-25°.

(Stark and Dehn, 1918.)

POTASSIUM LIGNOCERATE. $C_{23}H_{47}COOH$.100 gms. aq. 91.53 wt. per cent ethyl alcohol dissolve 0.153 gm. potassium lignocerate at 25° and the solution has $d_{20} = 0.80935$.

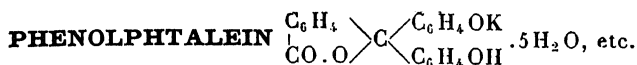
(Thomas and Yu, 1923.)

POTASSIUM Salt of CARYOPHYLLIN $K(C_{30}H_{48}O_4 \cdot 11/7H_2O)$.

100 gms. Ethyl alcohol dissolve 2.78 gms. of the salt at 20°.

" Methyl alcohol " 50.0 " " "

(Dodge, 1918.)



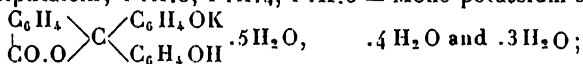
EQUILIBRIUM IN THE SYSTEM POTASSIUM HYDROXIDE, PHENOLPHTHALEIN AND WATER at 25°. (Bassett and Bagnall, 1924.)

NOTE. — Saturation was obtained by constant rotation for not less than 3 days of mixtures of phenolphthalein and aqueous potassium hydroxide solutions of various strengths. Such concentrations were chosen that a liquid and a solid phase was obtained in all cases. Both the saturated solution and the solid phase was analyzed. No solid colored salt was obtained. The results are expressed in terms of phenolphthalein anhydride ($\text{C}_{20}\text{H}_{12}\text{O}_3$) potassium oxide (K_2O) and water.

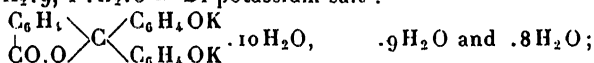
Gms. per 100 gms. sat. sol.			Gms. per 100 gms. sat. sol.			Gms. per 100 gms. sat. sol.		
K_2O	$\text{C}_{20}\text{H}_{12}\text{O}_3$	Solid Phase.	K_2O	$\text{C}_{20}\text{H}_{12}\text{O}_3$	Solid Phase.	K_2O	$\text{C}_{20}\text{H}_{12}\text{O}_3$	Solid Phase.
4.96	13.86	P	17.31	39.01	P. $\text{K}_2.8$	29.50	2.03	P. $\text{K}_3.8$
7.49	24.20	"	17.15	44.90	P. $\text{K}_3.4$	24.74	10.70	P. $\text{K}_3.7$
8.25	25.06	P. $\text{K}_2.5$	16.50	40.74	"	30.90	1.14	"
8.97	27.75	"	16.98	39.22	"	31.65	0.76	"
12.43	38.74	"	16.60	37.06	"	34.32	0.06	"
13.22	39.91	"	17.72	33.24	P. $\text{K}_3.9$	36.24	—	"
11.26	33.60	P. $\text{K}_2.4$	19.84	27.47	"	39.10	—	"
14.14	41.59	"	21.57	22.11	"	39.57	—	P. $\text{K}_3.6$
13.19	40.34	P. $\text{K}_2.3$	17.80	35.67	"	42.14	—	"
15.11	44.31	"	19.68	30.90	"	43.62	—	P. $\text{K}_3.5$
15.77	45.76	P. $\text{K}_2.10$	22.21	19.47	P. $\text{K}_3.8$	45.60	—	"
15.88	44.66	"	24.74	10.70	"	46.49	—	P. $\text{K}_3.4$
16.44	43.50	P. $\text{K}_2.9$	25.64	8.15	"	47.44	—	"
15.92	43.80	P. $\text{K}_2.8$	28.27	3.10	"	45.44	—	" + $\text{KOH} \cdot 2\text{H}_2\text{O}$
16.62	42.62	"	28.98	2.69	"			

P = Phenolphthalein; P. $\text{K}_2.5$, P. $\text{K}_2.4$, P. $\text{K}_2.3$ = Mono potassium salt :

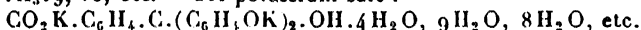
C_{14}H



P. $\text{K}_2.10$, P. $\text{K}_2.9$, P. $\text{K}_2.8$ = Di potassium salt :



P. $\text{K}_3.4$, P. $\text{K}_3.9$, .8, etc. = Tri potassium salt :



POTASSIUM LAURATE $\text{CH}_3(\text{CH}_2)_{10}\text{COOK}$

100 gms. Water dissolve approx. 70.0 gms. $\text{CH}_3(\text{CH}_2)_{10}\text{COOK}$ at 25°.

" " Benzene " " 0.005 " " "

Results are also given for the extraction of lauric acid from aqueous solutions of potassium laurate and of sodium laurate by means of benzene. (McBain and Eaton, 1928.)

The phase rule diagrams for equilibrium in the system potassium laurate + lauric acid + water, at temperatures between 100° and 370° are given by McBain and Field, 1933. Due to high viscosity, even at 90°, months may be required for the separation of the liquid phases. The existence of acid soaps is demonstrated by the separation of crystalline sediments from dilute solutions of soluble soap such as potassium laurate. At 370° the three components are almost but not quite soluble in all proportions.

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POTASSIUM STEARATE $\text{CH}_3(\text{CH}_2)_{16}\text{COOK}$.

100 gms. aq. alcohol of $d_{25} = 0.80935$ ($= 91.53$ wt. % $\text{C}_2\text{H}_5\text{OH}$) dissolve 0.633 gm. $\text{CH}_3(\text{CH}_2)_{16}\text{COOK}$ at 25° . (Thomas and Yu, 1923.)

SOLUBILITY OF POTASSIUM STEARATE AND OF POTASSIUM PALMITATE IN AQUEOUS ETHYL ALCOHOL AT 18° .

(Scherlinga, 1932.)

Potassium Stearate		Potassium Palmitate	
Gms. $\text{C}_2\text{H}_5\text{OH}$ per 100 gms. Solvent	Gms. $\text{CH}_3(\text{CH}_2)_{16}\text{COOK}$ per 100 gms. sat. sol.	Gms. $\text{C}_2\text{H}_5\text{OH}$ per 100 gms. Solvent	Gms. $\text{CH}_3(\text{CH}_2)_{14}\text{COOK}$ per 100 gms. sat. sol.
49	4.4	49	45.0*
66	2.6	66	19.0
79.5	1.8	79.5	6.5
96	0.62	96	1.4

* This result uncertain on account of the colloidal character of the Solution.

POTASSIUM OLEATE $\text{C}_8\text{H}_{17}\text{CH}:\text{CH}(\text{CH}_2)_7\text{COOK}$.

100 gms. of aq. 91.53 wt. per cent $\text{C}_2\text{H}_5\text{OH}$ dissolve 41.1 gms. $\text{C}_{18}\text{H}_{33}\text{O}_2\text{K}$ at 25° and the saturated solution has $d = 0.80935$. (Thomas and Yu, 1923.)

Results are given by McBain and Stewart, 1933, for equilibrium in the System Potassium Oleate + Oleic Acid, determined by observing the temperature of disappearance of the last crystal upon heating, and the first appearance of turbidity upon cooling known mixtures of the two components contained in sealed evacuated tubes. An acid soap of the composition, $\text{C}_8\text{H}_{17}\text{CH}:\text{CH}(\text{CH}_2)_7\text{COOK} \cdot \text{C}_8\text{H}_{17}\text{CH}:\text{CH}(\text{CH}_2)_7\text{COOH}$ exists below its transition temp. of 47° .

POTASSIUM CYANIDE KCN.

100 gms. H_2O dissolve 122.2 gms. KCN, or 100 gms. sat. solution contain 55 gms. KCN at 103.3° . (Griffiths.)

100 gms. abs. ethyl alcohol dissolve 0.87 gm. KCN at 19.5° .

100 gms. abs. methyl alcohol dissolve 4.91 gms. KCN at 19.5° . (de Bruyn, 1892.)

100 gms. glycerol dissolve 32 gms. KCN at 15.5° . (Ossendowski, 1907.)

100 gms. hydroxylamine dissolve 41 gms. KCN at 17.5° . (de Bruyn, 1892.)

100 gms. liquid ammonia (NH_3) dissolve 4.55 gms. KCN at -33.9° and the density of the sat. solution is 0.7034. (Johnson and Krumboltz, 1933.)

100 gms. liquid sulfur dioxide (SO_2) dissolve 0.017 gm. KCN at 0° .

(Jander and Ruppolt, 1937.)

F-pt. data for KCN + KCl, KCN + NaCN, KCN + AgCN, KCN + $\text{Cu}_2(\text{CN})_2$ and for KCN + $\text{Zn}(\text{CN})_2$ are given by Truthe (1912).

POTASSIUM CHROMOCYANIDE $\text{K}_3\text{Cr}(\text{CN})_6$.

100 gms. H_2O dissolve 32.33 gms. $\text{K}_3\text{Cr}(\text{CN})_6$ at 20° .

(Moissan, 1885; Christensen, 1885.)

POTASSIUM CHROMITHIOCYANATE $\text{K}_2\text{Cr}(\text{SCN})_6 \cdot 4\text{H}_2\text{O}$.

100 gms. H_2O dissolve 139 gms. salt.

(Karsten, 1864-5.)

SOLUBILITY OF POTASSIUM CYANIDE IN AQUEOUS SOLUTIONS OF NICKEL CYANIDE
AT 25° AND VICE VERSA. (Corbet, 1926.)

Note. In the case of this and the following experiments by Bassett and Corbet the authors prepared the KCN from pure double salts in order to obtain it free of KOH. In order to prevent oxidation an atmosphere of coal gas previously passed through solutions of lead acetate and sodium hydroxide was maintained in the bottles. Both the liquid and the solid phases were analyzed.

Gms. per 100 gms. sat. sol.		Solid. Phase.	Gms. per 100 gms. sat. sol.		Solid. Phase.
KCN.	Ni(CN) ₂ .		KCN.	Ni(CN) ₂ .	
39.85	1.00	KCN	23.97	10.82	K ₂ Ni(CN) ₄ .H ₂ O
38.79	1.88	»	23.14	10.34	»
37.64	4.69	»	16.82	14.29	»
*41.11	6.56	»	16.82	13.94	» + Ni(CN) ₂
39.09	5.95	KCN + K ₂ Ni(CN) ₄ .H ₂ O	10.58	9.13	Ni(CN) ₂
30.94	7.46	K ₂ Ni(CN) ₄ .H ₂ O	0.28	0.23	»

*Unstable equilibrium.

SOLUBILITY OF POTASSIUM CYANIDE IN AQUEOUS SOLUTIONS
OF POTASSIUM HYDROXIDE AT 25°. (Basset and Corbet, 1924.)

Gms. per 100 gms. sat. sol.			Gms. per 100 gms. sat. sol.		
KCN.	KOH*.	KCN + KOH.	KCN.	KOH*.	KCN + KOH.
41.56	0.11	41.67	34.72	7.39	42.11
41.67	0.69	42.36	33.58	8.96	42.54
38.92	3.3	42.22	26.39	16.29	42.68

*In terms of KCN. These results show that KOH decreases the solubility of KCN in water. Hence accurate results require that KCN free of KOH must be used for solubility determinations.

SOLUBILITY OF POTASSIUM CYANIDE IN AQUEOUS SOLUTIONS OF THALLIUM CYANIDE
AT 25° AND VICE VERSA. (Bassett and Corbet, 1924.)

Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase.
KCN.	TlCN.		KCN.	TlCN.	
41.7	0.0	KCN	34.36	4.90	TlCN
40.83	0.71	»	35.09	4.96	»
39.76	1.65	»	31.25	4.46	»
37.0	3.17	» + KTI(CN) ₂	30.21	5.00	»
37.5	3.11	KTI(CN) ₂	28.07	4.47	»
36.47	4.16	»	21.00	4.36	»
36.52	4.12	»	14.75	5.46	»
35.93	5.78	»	9.12	7.17	»
36.00	4.99	TlCN	0.51	16.20	»
35.27	4.98	»	0.34	16.12	»
34.45	4.91	»	0.00	16.51	»

SOLUBILITY OF POTASSIUM CYANIDE IN AQUEOUS SOLUTIONS OF ZINC CYANIDE
AT 25° AND VICE VERSA. (Corbet, 1926.)

Gms. per 100 gms. sat. sol.			Gms. per 100 gms. sat. sol.		
KCN.	Zn(CN) ₂ .	Solid Phase.	KCN.	Zn(CN) ₂ .	Solid Phase.
41.7	0.00	KCN	18.22	0.47	K ₂ Zn(CN) ₄
41.15	trace	» + K ₂ Zn(CN) ₄	14.17	1.50	»
39.04	trace	K ₂ Zn(CN) ₄	7.65	5.75	»
37.15	0.12	»	6.64	5.86	»
34.46	0.17	»	6.77	6.97	» + Zn(CN) ₂
32.65	0.20	»	3.81	3.33	Zn(CN) ₂
23.56	0.67	»	2.50	2.30	»

POTASSIUM ZINC CYANIDE K₂Zn(CN)₄.

100 cc. H₂O dissolve 11 gms. K₂Zn(CN)₄ at 20°.

(Sharwood, 1903.)

POTASSIUM FERRICYANIDE K₃Fe(CN)₆

SOLUBILITY OF POTASSIUM FERRICYANIDE IN WATER.

(Friend and Smirles, 1926.)

CN

t°	d of sat. sol.	Gms. K ₃ Fe(CN) ₆ per 100 gms. H ₂ O	t°	d of sat. sol.	Gms. K ₃ Fe(CN) ₆ per 100 gms. H ₂ O
0.1	—	23.22	29.8	—	36.65
4.7	—	25.49	33.1	1.2045	—
7.8	1.1567	26.96	39.9	1.2115	37.22
15.7	1.1738	30.35	49.0	—	39.12
18.7	—	30.96	56.25	—	40.41
22.1	1.1872	32.08	58.0	1.2269	41.10
25.0	—	32.80	81.0	—	44.70
26.3	1.1928	33.66	99.0	—	47.60

The solid phase is K₃Fe(CN)₆ in all cases and there is no indication of a break in the solubility or density curve. The saturated solutions were prepared by continuous agitation for 6 hours and analyzed by a gravimetric determination of the Fe. The previous determinations of Wallace, 1855; Schiff, 1860 and Grube, 1916 are slightly lower than the present results.

One liter sat. sol. in 0.4687 N KOH contains 342.7 gms. K₃Fe(CN)₆ at 25°. (Grube, 1914.)

" " 0.9628 " " 302.3 " " " "

" " 1.949 " " 215.1 " " " "

100 cc. anhy. hydrazine dissolve 2 gms. K₃Fe(CN)₆ at room temp.

(Welsh and Broderson, 1915.)

100 gms. methyl alcohol dissolve 0.31 gm. Potassium ferricyanide at the b. pt. (66°). (Henstock, 1934.)

POTASSIUM FERROCYANIDE $K_4Fe(CN)_6 \cdot 3H_2O$

SOLUBILITY OF POTASSIUM FERROCYANIDE IN WATER.

(Harkins & Pearce, 1916; Fabris, 1921, 1931, 1932; Vallance, 1922; Farrow, 1926; Rovalini and Fabris, 1933.)

The results of the above named investigators were plotted on cross section paper and from the average curve drawn through them the following values were read.

t°	d of sat. sol.	Gms. $K_4Fe(CN)_6$ per 100 gms. sat. sol.	Solid Phase	t°	d of sat. sol.	Gms. $K_4Fe(CN)_6$ per 100 gms. sat. sol.	Solid Phase
-0.24	—	1.25	Ice	50	1.2350	32.6	$K_4Fe(CN)_6 \cdot 3H_2O$
-0.62	—	4.0	"	65	1.2635	36.8	"
-1.09	—	8.0	"	70	—	38.2	"
-1.6	Inter-	11.6	" + $K_4Fe(CN)_6 \cdot 3H_2O$	80	1.2854	40.1	"
0	—	12.5	$K_4Fe(CN)_6 \cdot 3H_2O$	87.3	—	41.34	" + $K_4Fe(CN)_6$
5	—	15.0	"	94	—	41.99	$K_4Fe(CN)_6$
10	—	17.36	"	99.6	—	42.63	"
15	—	19.3	"	104.1	—	44.77	"
20	—	22.0	"	88.3	—	41.68*	$K_4Fe(CN)_6 \cdot 3H_2O$
25	1.1731	24.0	"	90	—	42.24*	"
30	—	26.0	"	94	—	43.91*	"
35	1.2018	27.8	"	95.8	—	44.74*	"

* Metastable

SOLUBILITY OF POTASSIUM FERROCYANIDE IN WATER AT TEMPERATURES UP TO 25° .
(Vallance, 1927.)

The author first compared the available methods of estimating potassium ferrocyanide in solution and selected as most accurate, the method based upon decomposition of the dry salt with conc. H_2SO_4 and a little HNO_3 , and finally dissolving in conc. HCl , diluting and precipitating the Fe with ammonia, filtering, igniting and weighing. The very careful solubility determinations give a curve in which there is a break at about 18° . No difference in the crystal form or composition, $K_4Fe(CN)_6 \cdot 3H_2O$ of the solid phase, above and below this point could be detected. The density curve of the saturated solutions also shows a slight change in direction above 17° . The dilatometric method shows a transition point at 17.7° .

t°	d of sat. sol.	Gms. $K_4Fe(CN)_6$ per 100 gms. sat. sol.	t°	d of sat. sol.	Gms. $K_4Fe(CN)_6$ per 100 gms. sat. sol.
15	1.1378	19.52	19.0	1.1505	21.08
16	1.1415	20.00	20.0	1.1543	21.9
17	1.1455	21.00	22.5	1.1615	22.7
17.7	1.1471	25.64	25.0	1.1701	23.97

SOLUBILITY OF POTASSIUM FERROCYANIDE IN Aq. POTASSIUM HYDROXIDE SOLUTIONS AT 25° (Grube, 1914.)

Solvent.	Gms. $K_4Fe(CN)_6 \cdot 3H_2O$ per 1000 cc. Sat. Sol.	Solid Phase.	Solvent.	Gms. $K_4Fe(CN)_6 \cdot 3H_2O$ per 1000 cc. Sat. Sol.	Solid Phase.
0.09984 n KOH	308.5	$K_4Fe(CN)_6 \cdot 3H_2O$	0.9415 n KOH	184.8	$K_4Fe(CN)_6 \cdot 3H_2O$
0.2496 "	283.5	"	1.395 "	132.1	"
0.4963 "	247.1	"	1.883 "	86.12	"
0.7036 "	217.4	"			

CN

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SOLUBILITY OF MIXTURES OF POTASSIUM FERROCYANIDE AND FERRICYANIDE IN WATER AND IN AQUEOUS POTASSIUM HYDROXIDE SOLUTIONS AT 25°. (Grube, 1914.)

Solvent.	Gms. per 1000 cc. Sat. Solution.		Solid Phase.
	$K_3Fe(CN)_6$	$K_4Fe(CN)_6$	
Water	338.1	79.02	$K_3Fe(CN)_6 + K_4Fe(CN)_6 \cdot 3H_2O$
0.4687 <i>n</i> KOH	309	66.64	" "
0.9628 "	275.3	55.19	" "
1.949 "	200.8	35.95	" "

SOLUBILITY OF POTASSIUM FERROCYANIDE IN AQUEOUS SOLUTIONS OF SODIUM FERROCYANIDE AT 25° AND VICE VERSA. (Harkins and Pearce, 1916.)

Mols. per 1000 Gms. H_2O .		Gms. $K_4Fe(CN)_6$ per 1000 H_2O .	d_{20} of Sat. Sol.	Mols. per 1000 Gms. H_2O .		Gms. $Na_4Fe(CN)_6$ per 1000 H_2O .	d_{20} of Sat. Sol.
$Na_4Fe(CN)_6$	$K_4Fe(CN)_6$			$K_4Fe(CN)_6$	$Na_4Fe(CN)_6$		
0	0.89459	329.5	1.09081	0	0.6818	205.25	1.0505
0.05072	0.88272	325.1	1.0990	0.1327	0.7056	214.47	1.0109
0.06633	0.88544	326	1.10039	0.1789	0.7213	219.23	1.0702
0.12306	0.88088	324.4	1.09350	0.2115	0.7253	220.44	1.1006
0.25972	0.89116	328.3	1.12796	0.2722	0.7610	231.20	1.1113
0.4000	0.91600	337.4	1.17241	0.3532	0.7814	237.49	1.1243
0.87034	0.99000	364.6	1.19700	0.5850	0.8652	262.07	1.1567
0.91060	1.01200	372.3	1.21190	0.6111	0.8712	264.70	1.1581
0.95879	1.05177	387.5	1.22673	0.6904	0.8984	273.05	1.1830
1.0438	1.1159	411	1.25789	1.0578	0.9588	291.40	1.2267

CN

EQUILIBRIUM IN THE SYSTEM POTASSIUM FERROCYANIDE, POTASSIUM SULFATE AND WATER.
(Bovalini and Fabris, 1938.)

t°	Gms. per 100 gms. sat. sol.		Solid Phase	t°	Gms. per 100 gms. sat. sol.		Solid Phase
	$K_4Fe(CN)_6$	K_2SO_4			$K_4Fe(CN)_6$	K_2SO_4	
-1.6	11.58	0.0	Ice + K_3	65	38.81	0.0	K_3
-2.05	9.07	4.62	" " + K_2SO_4	"	33.645	3.215	" + K_2SO_4
0	9.80	4.83	" "	"	0.0	16.0	K_2SO_4
0	12.48	0.0	" "	74	38.75	0.0	K_3
0	0.0	6.82	K_2SO_4	"	36.30	3.295	" + K_2SO_4
30	25.94	0.0	K_3	"	0.0	16.92	K_2SO_4
"	24.17	0.902	"	85	40.72	0.0	K_3
"	22.97	2.231	"	"	38.715	2.975	" + K_2SO_4
"	22.23	3.902	" + K_2SO_4	"	0.0	18.11	K_2SO_4
"	16.45	5.535	K_2SO_4	86.3	39.03	2.80	K_3 + $K_4Fe(CN)_6$ + K_2SO_4
"	11.08	7.126	"	90	41.38	0.0	$K_4Fe(CN)_6$
"	8.54	7.818	"	"	40.14	1.030	"
"	5.01	9.59	"	"	39.75	1.410	"
"	3.03	10.205	"	"	39.30	2.770	"
"	0.0	11.53	"	"	39.165	3.831	" + K_2SO_4
40	29.28	0.0	K_3	"	32.11	4.30	K_2SO_4
"	28.58	1.288	"	"	30.36	5.26	"
"	27.50	2.468	"	"	17.20	9.92	"
"	25.66	3.982	" + K_2SO_4	"	14.67	11.09	"
"	19.63	5.495	K_2SO_4	"	5.46	15.42	"
"	15.21	7.031	"	"	0.0	18.60	"
"	10.36	8.557	"	104.1 (b.p.L)	44.77	0.0	$K_4Fe(CN)_6$
"	8.56	8.930	"	104.3	39.356	3.344	" + K_2SO_4
"	5.88	10.111	"	101.4	0	19.50	K_2SO_4
"	3.03	11.306	"				
"	0.0	12.90	"				

$K_3 = K_4Fe(CN)_6 \cdot 3H_2O$

SOLUBILITY OF POTASSIUM FERROCYANIDE IN AQUEOUS
SOLUTIONS OF AMMONIA AT 18°.

(Tettamanzi, 1933.)

Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase
NH ₃	K ₄ Fe(CN) ₆		NH ₃	K ₄ Fe(CN) ₆	
0.0	21.21	K ₄ Fe(CN) ₆ ·3H ₂ O	20.60	0.872	K ₄ Fe(CN) ₆ ·3H ₂ O
4.51	11.20	"	22.37	0.750	"
9.13	5.65	"	23.62	0.645	"
11.86	3.76	"	25.05	0.497	"
15.19	2.24	"	26.95	0.427	"
16.79	1.53	"	34.09	0.157	"
18.11	1.16	"			

100 gms. Methyl Alcohol dissolve 0.90 gm. Potassium ferrocyanide at the b. pt. (66°). (Henstock, 1934.)

EQUILIBRIUM IN THE SYSTEM POTASSIUM FERROCYANIDE, TERTIARY
BUTYL ALCOHOL AND WATER AT 25°.

(Ginnings, Herring and Webb, 1933.)

The composition of the homogeneous mixture (plait point) of this system was found to be

4.3 percent K₃Fe(CN)₆ + 38.0 percent ter. (CH₃)₃COH + 57.7 percent H₂O

The original results for the remaining points on the binodal curve are not given but only the values of a series of arbitrary constants calculated from them by means of empirical equations.

SOLUBILITY OF POTASSIUM FERROCYANIDE IN
AQUEOUS SOLUTIONS OF ETHYL ALCOHOL AT 20°.

(Diaz de Rada and Bermejo, 1929.)

Vol. Percent C ₂ H ₅ OH in Solvent	Gms. K ₄ Fe(CN) ₆ per 100 gms. sat. sol.	Vol. Percent C ₂ H ₅ OH in Solvent	Gms. K ₄ Fe(CN) ₆ per 100 gms. sat. sol.
0 (= H ₂ O)	22.01	45	0.352
5	16.40	50	0.229
10	10.47	55	0.143
15	6.61	60	0.094
20	3.995	65	0.057
25	2.394	70	0.053
30	1.420	75	0.039
35	0.789	80	0.025
40	0.565	85	none

POTASSIUM CYANATE KCNO.

SOLUBILITY IN ALCOHOLIC MIXTURES.

(Erdmann, 1893.)

Solvent.	Gms. KCNO per Liter Solvent at b.-pt.
80 per cent Alcohol + 20 per cent Water	62
80 per cent Alcohol + 20 per cent Methyl Alcohol	76
80 per cent Alcohol + 10 per cent Acetone	82
100 gms. alcohol of $d_{15} = 0.799$ dissolve 0.16 gm. KCNO at 0° and 0.53 gm. at b. pt.	
" " 80% concentration dissolve 1.9 gms. KCNO at 0° and 6.2 gms. at b. pt.	
" benzene dissolve 0.18 gm. KCNO at b. pt. (Granston and Livingstone, 1926.)	
100 gms. liquid Ammonia, NH ₃ , dissolve 1.7 gm. KCNO at 25°.	
" cc. " " " 1.02 " " " "	

(Hunt, 1932.)

POTASSIUM Platino CYANIDE $K_2Pt(CN)_4 \cdot 3H_2O$.

SOLUBILITY OF POTASSIUM PLATINO CYANIDE IN WATER. (Torrey and Jolly, 1901)

Saturation secured by constant stirring in a thermostat.

t°	Gms. $K_2Pt(CN)_4$ per 100 gms. H_2O .	Solid Phase.	t°	Gms. $K_2Pt(CN)_4$ per 100 gms. H_2O .	Solid Phase.
0.1.....	11.60	$K_2Pt(CN)_4 \cdot 3H_2O$	45.0....	91.43	$K_2Pt(CN)_4 \cdot 3H_2O$
9.8.....	19.76	"	49.9....	109.20	"
14.4.....	26.53	"	52.4 tr. pt.	"	" + $K_2Pt(CN)_4$
13.35 tr. pt.	"	" + $K_2Pt(CN)_4 \cdot 3H_2O$	55.4....	127.5	$K_2Pt(CN)_4 \cdot 2H_2O$
16.38....	28.63	$K_2Pt(CN)_4 \cdot 3H_2O$	60.4....	139.1	"
17.42....	29.02	"	67.5....	156.9	"
20.05....	33.83	"	74.1 tr. pt.	171.2	" + $K_2Pt(CN)_4$
22.65....	37.73	"	78.2....	173.2	$K_2Pt(CN)_4 \cdot 2H_2O$
25.0....	41.93	"	83.6....	178.3	"
35.0....	64.16	"	87.2....	184.0	"
39.75....	78.23	"	91.0....	210.0	"

The transition temperatures (tr. pt.) were determined by the dilatometric method.

POTASSIUM THIOCYANATE KCNS

CNS

SOLUBILITY OF POTASSIUM THIOCYANATE IN WATER.

(Up to 25°, Rudorff, 1869, 1872; Foote, 1903; Wassilijew, 1910. Occleshaw, 1931. At the higher temperatures, Kracek, 1936.)

The determinations of Kracek were made by observing the temperature of disappearance of the last crystal in mixtures of KCNS + H_2O contained in sealed tubes. A polymorphic inversion of KCNS occurs at 140.6°, hence the solubility curve has a break at that point.

t°	Gms. KCNS per 100 gms. H_2O sat. sol.		Solid Phase	t°	Gms. KCNS per 100 gms. H_2O sat. sol.		Solid Phase
-6.5	20.0	16.7	Ice	99.0	673.6	87.09	KCNS II
-9.55	30.0	23.1	"	108.4	802.9	88.94	"
-31.2	101.0	50.24	" + KCNS	116.8	956.2	90.51	"
0	177	63.9	KCNS II	124.6	1150.2	92.00	"
20	217	68.45	"	130.7	1346.2	93.07	"
25	239	70.50	"	140.6	1825.6	94.82	"
32.6	265.1	72.61	"	142.7	1957.7	95.13	KCNS I
47.3	317.05	76.03	"	149.4	2471.1	96.12	"
57.0	358.6	78.18	"	157.4	3599.6	97.29	"
66.7	408.45	80.34	"	169.2	9342.0	98.93	"
74.5	455.9	82.02	"	176.8	M. pt.		"
84.2	526.9	84.05	"				

Chretien and Hoffer, 1935, by means of the crystallization diagram, found metastable crystalline forms of KCNS having 1/2 and 4/5 mol. of H_2O at temperatures between the eutectic (-33.2°) and + 6.8°.

100 gms. liquid Sulfur Dioxide, SO_2 , dissolve 4.87 gms. KCNS at 0°.
(Jaeder and Ruppolt, 1937.)

SOLUBILITY OF POTASSIUM THIOCYANATE IN ACETONE, AMYL ALCOHOL, ETC.

(von Laszcynski, 1894.)

In Acetone.		In Amyl Alcohol.		In Ethyl Acetate.		In Pyridine.	
t°.	Gms. KSCN per 100 Gms. (CH ₃) ₂ CO.	t°.	Gms. KSCN per 100 Gms. C ₅ H ₁₁ OH.	t°.	Gms. KSCN per 100 Gms. CH ₃ COOC ₂ H ₅ .	t°.	Gms. KSCN per 100 Gms. C ₅ H ₅ N.
22	20.75	13	0.18	0	0.44	0	6.75
58	20.40	65	1.34	14	0.40	20	6.15
		100	2.14	79	0.20	58	4.97
		133.5	3.15			97	3.88
						115	3.21

EQUILIBRIUM IN THE SYSTEM POTASSIUM THIOCYANATE,
TERTIARY BUTYL ALCOHOL AND WATER AT 25°.

(Ginnings, Herring and Webb, 1933.)

The composition of the homogeneous mixture (plait point) of this system was found to be:

37.9 percent KSCN + 19.3 percent ter. (CH₃)₃COH + 42.8 percent H₂O

The original results for the remaining points on the binodal curve are not given but only the values of a series of arbitrary constants calculated from them by means of empirical equations.

SOLUBILITY OF POTASSIUM THIOCYANATE IN PYRIDINE, DETERMINED BY
THE SYNTHETIC METHOD.

(Wagner and Zerner, 1911.)

t°.	Gms. KSCN per 100 Gms. Mixture.	Solid Phase.	t°.	Gms. KSCN per 100 Gms. Mixture.	Solid Phase.
-42	0	C ₅ H ₅ N	70-71	1.23	KSCN
-42.1	0.5	"	116-117	0.89	"
-42.4	1.33	"	172.7	at this temperature two liquid layers appear and do not be- come homogeneous up to 200°.	
-42.8	2.4	"			
-43.3 Eutec.	3.1	" + KSCN			
about +10	2.2	KSCN	173.8 m. pt.	100	KSCN

100 gms. anhydrous acetonitrile dissolve 11.31 gms. KSCN at 18°.

(Naumann and Schier, 1914.)

Fusion-point data for mixtures of KSCN + NaSCN and KSCN + RbSCN are given by Wrzesnewsky (1912).

DISTRIBUTION OF POTASSIUM THIOCYANATE AT 17° BETWEEN WATER AND
AMYL ALCOHOL. (Wosnossensky, 1925.)

Millimols. KSCN per liter of		$\frac{C_1}{C_2^{0.7}}$	Millimols. KSCN per liter of		$\frac{C_1}{C_2^{0.7}}$
H ₂ O layer (C ₁).	Alcohol layer (C ₂).		H ₂ O layer (C ₁).	Alcohol layer (C ₂).	
155.40	2.329	88	640.235	17.379	86
338.82	7.090	86	1075.221	31.506	86
410.753	9.333	86			

POTASSIUM CARBONATE $K_2CO_3 \cdot 1\frac{1}{2}H_2O$

SOLUBILITY OF POTASSIUM CARBONATE IN WATER.

(Mulder, 1864; de Coppet, 1872; Meyerhoffer, 1906; Kremann and Zitek, 1909; de Waal, 1910; Osaka, 1910-12; Bain, 1927; Hill and Miller, Jr., 1927; Hill, 1930, 1930(a)).

t°	Gms. K_2CO_3 per 100 gms. sat. sol.	Solid Phase	t°	Gms. K_2CO_3 per 100 gms. sat. sol.	Solid Phase
-10	21.3	Ice	40	53.9	$K_2CO_3 \cdot 1\frac{1}{2}H_2O$
-20	31.	"	50	54.8	"
-30	36.9	"	60	55.9	"
-36.5	39.6	" + $K_2CO_3 \cdot 6H_2O$	70	57.1	"
-6.2 tr.pt.	50.9	$K_2CO_3 \cdot 6H_2O$ + $K_2CO_3 \cdot 1\frac{1}{2}H_2O$	80	58.3	"
0	51.25	$K_2CO_3 \cdot 1\frac{1}{2}H_2O$	90	59.6	"
+10	51.9	"	100	60.9	"
20	52.5	"	110	62.5	"
25	52.85	"	120	64.4	"
30	53.2	"	130	66.2	"

The density of the sat. solution at $5^\circ = 1.541$, at $25^\circ = 1.559$ and at $35^\circ = 1.560$. Other determinations not in good agreement with the above are given by Engel, 1888; Köhler, 1897; Greenish and Smith, 1901; Rubitzov, 1918; Blasdale, 1923; Iljinaki, 1924; Starkowa, 1931; and Appleby and Leishman, 1932. The last named investigators present evidence, based upon analyses of the wet solid phases in contact with the liquid layers formed in the system $K_2CO_3 + NH_3 + H_2O$ at 0° and at 25° , that the stable hydrate is $K_2CO_3 \cdot 2H_2O$ and not $K_2CO_3 \cdot 1\frac{1}{2}H_2O$.

Determinations of the equilibrium in aqueous solutions of potassium carbonate and bicarbonate in concentrations up to 2.5 gm. mol. per liter, in relation to the partial pressure of CO_2 in the gas phase in contact with the solution, are given by Walker, Bray & Johnston, 1927.

POTASSIUM BicARBONATE $KHCO_3$

SOLUBILITY OF POTASSIUM BICARBONATE IN WATER.

(Diblets, 1874; Engel, 1888; Greenish and Smith, 1901; de Forcrand, 1909; Foerster, Brosche and Norberg-Schulz, 1924; Hill and Hill, 1927; Oglesby, 1929; Hill, 1930(a); Starkowa, 1931; and Paris and Mondain-Monval, 1938.)

The results of the above named investigators varied very slightly from the smoothed curve from which the following values were read.

t°	d. of sat. sol.	Gms. $KHCO_3$ per 100 gms. sat. sol.	Solid Phase	t°	d. of sat. sol.	Gms. $KHCO_3$ per 100 gms. sat. sol.	Solid Phase
-0.70	—	2.17	Ice	20	1.174	25.0	$KHCO_3$
-2.16	—	5.77	"	25	1.188	26.6	"
-3.21	—	9.98	"	30	1.199	28.1	"
-3.90	—	12.60	"	40	1.217	31.3	"
-5.43 Eutec.	—	16.95	" + $KHCO_3$	50	—	34.2	"
0	1.130	18.6	$KHCO_3$	60	—	37.5	"
+10	1.154	21.8	"	70	—	40.6	"

SOLUBILITY OF POTASSIUM CARBONATE AND OF POTASSIUM BICARBONATE
EACH SEPARATELY IN WATER.
(Takahashi, 1927.)

Results for Potassium Carbonate

Results for Potassium Bicarbonate

t°	d. of sat. sol.	Gms. K_2CO_3 per 100 gms. sat. sol.	Solid Phase	t°	d. of sat. sol.	Gms. $KHCO_3$ per 100 gms. sat. sol.	Solid Phase
-11	1.533	50.45	$K_2CO_3 \cdot 2H_2O$	0	1.1329	18.41	$KHCO_3$
-5	1.5445	50.93	"	10	1.1544	21.53	"
0	1.546	51.35	"	20.5	1.1772	25.23	"
+5	1.5475	51.60	"	30	1.2004	28.52	"
10	1.549	51.90	"	40	1.2196	32.24	"
30	1.557	53.60	"	50	1.2439	36.04	"
50	1.570	55.73	"	60	1.2711	39.65	"
70	1.590	58.13	"	70	1.3005	43.37	"

In the case of the Bicarbonate results the solutions were under a pressure of 1 atmosphere of CO_2 .

SOLUBILITY OF POTASSIUM CARBONATE AND OF BICARBONATE IN WATER IN CONTACT
WITH ATMOSPHERES CONTAINING VARYING PERCENTAGES OF CARBON DIOXIDE.
(Takahashi, 1927.)

Results at 50°

Results at 70°

Percent CO_2 in Atmospheres	d. of sat. sol.	Gms. per 100 gm. sat. sol. $\underbrace{\quad K_2O \quad CO_2 \quad}_{\quad}$	Solid Phase	Percent CO_2 in Atmospheres	d. of sat. sol.	Gms. per 100 gm. sat. sol. $\underbrace{\quad K_2O \quad CO_2 \quad}_{\quad}$	Solid Phase
0	1.570	38.00 17.78	$K_2CO_3 \cdot 2H_2O$	0	1.590	39.65 18.48	$K_2CO_3 \cdot 2H_2O$
16	1.569	37.90 18.07	"	22	1.588	39.34 19.41	" + $KHCO_3$
18	1.570	37.43 17.90	" + $KHCO_3$	26	1.575	39.02 19.16	"
20	1.512	35.81 17.27	$KHCO_3$	50	1.550	36.36 18.44	$KHCO_3$
22	1.494	31.79 15.80	"	55	1.430	29.47 16.85	"
50	1.401	27.25 14.60	"	60	1.315	25.99 16.37	"
60	1.352	23.32 14.20	"	80	1.335	22.65 16.18	"
80	1.282	19.54 14.10	"	99.5	1.301	20.45 16.87	"
99.5	1.241	16.95 14.62	"				

SOLUBILITY OF POTASSIUM CARBONATE IN AQUEOUS SOLUTIONS OF
POTASSIUM BICARBONATE AND VICE VERSA AT SEVERAL TEMPERATURES.
(Nill, 1900(a).)

d. of sat. sol.	Gms. per 100 K_2CO_3	Gms. sat. sol. $KHCO_3$	Solid Phase	d. of sat. sol.	Gms. per 100 K_2CO_3	Gms. sat. sol. $KHCO_3$	Solid Phase
Results at 5°				Results at 35°			
1.543	51.53	0.0	K_2CO_3	1.560	53.56	0.0	K_2CO_3
1.555	50.59	1.72	" + 1.2.1½	1.571	51.68	3.26	" + 1.2.
—	50.03	1.77	1.2.1½	1.563	50.99	3.48	1.2.1½
1.543	49.91	1.90	"	1.564	50.58	3.62	"
1.542	49.65	1.96	" + $KHCO_3$	1.556	50.00	3.92	"
1.509	46.38	2.55	$KHCO_3$	1.556	49.51	4.27	" + $KHCO_3$
1.137	0.0	20.15	"	1.548	48.93	4.27	$KHCO_3$
Results at 25°				1.441	37.71	7.50	"
1.559	52.77	0.0	K_2CO_3	1.329	23.04	14.21	"
1.563	51.23	2.64	" + 1.2.1½	1.352	10.04	22.10	"
1.562	50.77	2.85	1.2.1½	1.208	0.97	28.82	"
1.554	50.28	3.02	"	1.200	0.0	29.60	"
1.549	49.77	3.22	"	Results at 50°			
1.545	49.48	3.33	" + $KHCO_3$	—	54.8	0.0	K_2CO_3
1.538	48.14	3.56	$KHCO_3$	1.584	52.85	3.83	" + 1.2.
1.485	42.82	4.67	"	1.581	51.97	4.40	1.2.1½
1.402	34.71	7.35	"	1.569	50.92	4.97	"
1.316	23.36	12.19	"	1.565	49.65	5.77	" + $KHCO_3$
1.272	16.98	15.45	"	—	0.0	34.2	$KHCO_3$
1.228	10.00	19.31	"				
1.187	0.0	26.78	"				

$K_{1\frac{1}{2}} = K_2CO_3 \cdot 1\frac{1}{2}H_2O$; $1.2.1\frac{1}{2} = K_2CO_3 \cdot 2KHCO_3 \cdot 1\frac{1}{2}H_2O$.

Results for the 42° isotherm for this system are given by Starkowa, 1931, but the author failed to find the double salt $K_2CO_3 \cdot 2KHCO_3 \cdot 1\frac{1}{2}H_2O$. The earlier results of Bagel, 1888, at 0°, for this system are also probably inaccurate since his value for K_2CO_3 in water varies so greatly from that of all other investigators.

SOLUBILITY OF POTASSIUM CARBONATE IN AQUEOUS SOLUTIONS OF POTASSIUM
CHLORIDE AND OF POTASSIUM HYDROXIDE AT 30°. (de Waal, 1910.)

Results for K_2CO_3 + KCl.			Results for K_2CO_3 + KOH.		
Gms. per 100 Gms. Sat. Sol.		Solid Phase.	Gms. per 100 Gms. Sat. Sol.		Solid Phase.
K_2CO_3	KCl.		K_2CO_3	KOH	
53.27	0	$K_2CO_3 \cdot 1\frac{1}{2}H_2O$	53.27	0	$K_2CO_3 \cdot 1\frac{1}{2}H_2O$
52.22	1.03	" + KCl	2.50	53.77	"
51.66	1.07	KCl	2.05	55.14	" + $KOH \cdot H_2O$
1.64	26.22	"	0	55.75	$KOH \cdot H_2O$
0	28.01	"			

SOLUBILITY OF POTASSIUM CARBONATE IN AQUEOUS SOLUTIONS OF POTASSIUM CHLORATE AND VICE VERSA AT 24° 2 AND AT 40°. (Iljinsky, 1924.)

NOTE. — Saturation was secured by active shaking at constant temperature. The attainment of equilibrium was controlled by successive density determinations and by analyses. In most cases the time required was 3 to 5 hours. For the triple points and those corresponding to double salts, several days were required. The solid phases were identified by analysis.

d of sat. sol.	Gms. per 100 gms. H ₂ O.		Solid Phase.	d of sat. sol.	Gms. per 100 gms. H ₂ O.		Solid Phase.
	KClO ₃ .	K ₂ CO ₃ .			KClO ₃ .	K ₂ CO ₃ .	
Results at 24°. 2.				Results at 24°. 2.			
1.550	0.0	112.6	K ₂ CO ₃ ·2H ₂ O	—	2.90	23.4	KClO ₃
—	0.35	111.6	»+KClO ₃	1.180	3.00	22.3	»
—	0.5	97.5	KClO ₃	1.100	4.50	10.1	»
—	0.35	96.8	»	1.045	8.10	0.0	»
1.500	0.55	95.2	»	Results at 40°.			
1.362	1.10	58.3	»	1.558	0.0	119.3	K ₂ CO ₃ ·2H ₂ O
1.362	1.15	56.5	—	1.539	2.2	109.8	»+KClO ₃
1.302	1.60	44.7	»	1.316	2.1	42.2	KClO ₃
1.220	2.20	31.3	»	1.195	5.5	24.4	»
1.218	2.40	29.3	»	1.073	14.2	0.0	»

EQUILIBRIUM IN THE SYSTEM POTASSIUM CARBONATE, POTASSIUM CHLORATE, SODIUM CARBONATE, SODIUM CHLORATE AND WATER AT 24° 2. (Iljinski, 1924.)

See note above

d of sat. sol.	Gms. per 100 gms. H ₂ O				Solid Phase
	K ₂ CO ₃ .	KClO ₃ .	Na ₂ CO ₃ .	NaClO ₃ .	
—	0.0	1.5	22.0	68.9	NaClO ₃ + Na ₂ CO ₃ ·7H ₂ O
—	0.0	2.6	22.2	66.9	» + KClO ₃
1.383	0.0	0.0	24.6	46.2	Na ₂ CO ₃ ·10H ₂ O + Na ₂ CO ₃ ·7H ₂ O
—	0.0	2.5	24.5	45.0	» + KClO ₃
1.398	27.7	0.7	33.6	0.0	» + Na ₂ CO ₃ ·K ₂ CO ₃ ·6H ₂ O + KClO ₃
1.516	89.9	0.6	7.7	0.0	K ₂ CO ₃ ·2H ₂ O + Na ₂ CO ₃ ·K ₂ CO ₃ ·6H ₂ O + KClO ₃
1.510	90.7	0.5	6.7	0.0	» + KClO ₃
1.530	92.8	0.4	6.0	0.0	»
1.528	100.7	0.8	1.3	0.0	»
1.552	111.6	0.3	0.0	0.0	»
—	0.0	2.6	22.2	66.9	NaClO ₃ + » + Na ₂ CO ₃ ·7H ₂ O
1.442	0.0	5.1	6.6	88.2	»
1.389	0.0	5.9	3.8	90.6	»
1.443	0.0	5.1	1.5	95.7	»
1.450	0.0	4.6	1.4	96.0	»
1.432	0.0	4.2	0.0	96.6	»
—	0.0	2.5	24.5	45.0	Na ₂ CO ₃ ·10H ₂ O + » + Na ₂ CO ₃ ·7H ₂ O
1.332	0.0	3.2	26.0	29.1	»
—	0.0	7.2	30.7	0.0	»
1.398	27.7	0.7	33.6	0.0	» + Na ₂ CO ₃ ·K ₂ CO ₃ ·6H ₂ O
1.433	54.1	0.6	15.2	0.0	» + »
1.516	89.9	0.6	7.7	0.0	K ₂ CO ₃ ·2H ₂ O + » + »
—	0.0	2.6	22.2	66.9	NaClO ₃ + » + Na ₂ CO ₃ ·7H ₂ O
—	0.0	2.5	24.5	45.0	Na ₂ CO ₃ ·10H ₂ O + »

EQUILIBRIUM IN THE SYSTEM POTASSIUM BICARBONATE
POTASSIUM CHLORIDE AND WATER.
(Faria and Mondain-Monval, 1938.)

In order to have an excess of CO_2 present, the authors used, for preparing the saturated solutions, water previously saturated at about 2° with CO_2 , instead of pure water. Saturation was thus affected under 1 to 2 atmospheres pressure of CO_2 .

d. of sat. sol.	Gms. per 100 gms. H_2O		Solid Phase	d. of sat. sol.	Gms. per 100 gms. H_2O		Solid Phase
	KCl	KHCO_3			KCl	KHCO_3	
Results at 10°				Results at 20° (con.)			
1.154	0.0	27.78	KHCO_3	1.218	29.69	15.22	$\text{KHCO}_3 + \text{KCl}$
1.164	9.08	20.87	"	1.204	31.11	10.08	KCl
1.175	15.08	17.82	"	1.180	32.00	5.12	"
1.195	23.93	13.75	"	1.174	34.15	0.0	"
1.204	27.45	12.55	" + KCl	Results at 29.85°			
1.181	29.54	5.17	KCl	1.197	0.0	19.21	KHCO_3
1.164	31.12	0.0	"	1.234	31.30	18.24	" + KCl
Results at 20°				1.181	37.08	0.0	KCl
1.177	0.0	33.19	KHCO_3	Results at 40°			
1.184	10.05	25.34	"	1.217	0.0	45.51	KHCO_3
1.180	15.33	22.03	"	1.249	33.03	22.00	" + KCl
1.198	20.14	19.35	"	1.189	40.15	0.0	KCl
1.207	24.31	17.33	"				

EQUILIBRIUM IN THE SYSTEM POTASSIUM CARBONATE, SODIUM CARBONATE,
POTASSIUM CHLORIDE, SODIUM CHLORIDE AND WATER AT 25° . (Hladsdale, 1923.)

Gms. per 100 gms. H_2O				Solid Phase.
K_2CO_3	K_2Cl_2	Na_2CO_3	Na_2Cl_2	
113.57	0.0	0.0	0.0	$\text{K}_2\text{CO}_3 \cdot \frac{1}{2} \text{H}_2\text{O}$
104.18	0.0	10.89	0.0	" " $\text{NaKCO}_3 \cdot 6 \text{H}_2\text{O}$
30.48	0.0	35.57	0.0	$\text{Na}_2\text{CO}_3 \cdot 7 \text{H}_2\text{O} +$ "
18.96	0.0	35.63	0.0	" " $\text{Na}_2\text{CO}_3 \cdot 10 \text{H}_2\text{O}$
0.0	0.0	25.67	23.51	NaCl "
0.0	16.29	0.0	29.88	" " KCl
110.68	2.07	0.0	0.0	$\text{K}_2\text{CO}_3 \cdot \frac{1}{2} \text{H}_2\text{O} +$ "
0.0	13.78	27.45	15.81	$\text{Na}_2\text{CO}_3 \cdot 10 \text{H}_2\text{O} +$ " + NaCl
25.79	0.0	27.04	10.59	" " " + $\text{Na}_2\text{CO}_3 \cdot 7 \text{H}_2\text{O}$
29.78	0.0	27.86	8.55	$\text{NaKCO}_3 \cdot 6 \text{H}_2\text{O} +$ " "
102.50	1.83	11.02	0.0	" " " + $\text{K}_2\text{CO}_3 \cdot \frac{1}{2} \text{H}_2\text{O}$
36.29	0.0	27.82	0.0	" " " KCl
33.64	9.78	25.79	0.0	" " " KCl
0.0	22.08	38.65	0.0	$\text{Na}_2\text{CO}_3 \cdot 10 \text{H}_2\text{O} +$ "

100 gms. H_2O dissolve 10.76 gms. K_2CO_3 + 2.66 gms. KNO_3 at 10° when both salts are present in excess. (Kremann and Zitek, 1909.)

100 gms. H_2O dissolve 10.53 gms. K_2CO_3 + 6.12 gms. Na_2CO_3 at 10° when both salts are present in excess (Kremann and Zitek, 1909). See also Potassium Sodium Carbonate.

Data for aqueous solutions of K_2CO_3 + KNO_3 + Na_2CO_3 + NaNO_3 , simultaneously saturated with two or more of the salts at 10° and at 25° , are also given by Kremann and Zitek (1909).

Data for the reciprocal salt pairs K_2CO_3 + $\text{BaSO}_4 \rightleftharpoons \text{K}_2\text{SO}_4$ + BaCO_3 at 25° , 80° and 100° are given by Meyerhoffer (1905).

An aqueous solution, simultaneously saturated with $\text{K}_2\text{CO}_3 \cdot 2\text{H}_2\text{O}$, K_2SO_4 and BaCO_3 , contains 53.1 gms. K_2CO_3 + 0.023 gm. K_2SO_4 at 25° . (Meyerhoffer, 1905.)

EQUILIBRIUM IN THE SYSTEM POTASSIUM CARBONATE AMMONIA AND WATER. (Applebey and Leishuan, 1932.)

Two liquid layers are formed at concentrations of ammonia above 2.5 percent. The concentrations are expressed in gms. per 100 gms. sat. solution.

t°	Aqueous Layer			Ammoniacal Layer			Solid Phase
	d. of sat. sol. NH_3		K_2CO_3	d. of sat. sol. NH_3		K_2CO_3	
0	1.539	0.0	50.69	—	—	—	$\text{K}_2\text{CO}_3 \cdot 2\text{H}_2\text{O}$
"	1.517	1.06	49.37	—	—	—	"
"	1.507	1.57	48.84	—	—	—	"
"	1.483	2.51	47.42	—	—	—	"
"	1.475	2.52	47.13	0.901	32.07	2.72	"
"	1.421	3.26	42.54	0.921	27.41	2.99	"
"	1.371	3.70	39.44	0.946	24.59	3.73	"
"	1.340	4.41	35.95	0.968	22.02	5.84	"
"	1.240	6.91	28.92	1.038	16.17	12.44	"
"	1.109	12.09	18.51	1.109	12.09	18.51	(critical solution)
"	—	—	—	—	42.9	2.3	$\text{K}_2\text{CO}_3 \cdot 2\text{H}_2\text{O}$
18.05	1.550	0.0	51.72	—	—	—	"
"	1.455	2.88	46.50	0.894	30.48	4.76	"
"	1.407	2.75	43.6	0.917	27.24	5.98	"
"	1.404	2.83	42.78	0.919	26.75	6.15	"
"	1.351	4.14	39.31	0.950	23.08	8.87	"
"	1.104	12.74	21.05	1.104	12.74	21.05	(critical solution)
"	—	—	—	—	61.95	2.10	$\text{K}_2\text{CO}_3 \cdot 2\text{H}_2\text{O}$
25.06	1.556	0.0	51.47	—	—	—	"
"	—	0.550	50.91	—	—	—	"
"	—	1.004	50.91	—	—	—	"
"	—	1.286	50.30	—	—	—	"
"	—	1.842	49.77	—	—	—	"
"	—	2.885	48.79	—	—	—	"
"	—	3.450	47.00	—	30.85	4.83	"
"	—	4.79	40.69	—	25.81	7.48	"
"	—	6.04	36.36	—	21.98	10.85	"
"	—	8.19	30.94	—	8.19	30.94	(critical solution)

Experiments indicate that the upper critical solution temperature is probably above 155° . It was also found that the vapor pressure of the two liquid layers in contact with $\text{K}_2\text{CO}_3 \cdot 2\text{H}_2\text{O}$ becomes greater than atmospheric at about 22.5° .

SOLUBILITY OF POTASSIUM CARBONATE IN AQUEOUS
SOLUTIONS OF POTASSIUM SULFATE AT 25° AND VICE VERSA.
(Hill and Moskowitz, 1929.)

d. of sat. sol.	Gms. per 100 gms. sat. sol.		Solid Phase	d. of sat.	Gms. per 100 gms. sat. sol.		Solid Phase
	K_2SO_4	K_2CO_3			K_2SO_4	K_2CO_3	
1.557	0.0	52.8	$K_2CO_3 \cdot 1\frac{1}{2}H_2O$	1.230	1.5	23.2	K_2SO_4
1.557	0.03	52.8	" + K_2SO_4	1.170	2.8	16.4	"
1.506	0.03	48.0	K_2SO_4	1.122	4.9	9.4	"
1.465	0.08	45.1	"	1.103	6.5	5.5	"
1.348	0.3	35.0	"	1.083	10.7	0.0	"

POTASSIUM Magnesium CARBONATE $K_2Mg(CO_3)_2 \cdot 4H_2O$.

SOLUBILITY OF POTASSIUM MAGNESIUM CARBONATE IN
AQUEOUS SOLUTIONS OF POTASSIUM CHLORIDE AT 17°.
(Halla, 1926.)

Gm. Mols. per 1000 gms. H_2O		Solid Phase
KCl	$K_2Mg(CO_3)_2$	
0.274	0.0381	$K_2Mg(CO_3)_2 \cdot 4H_2O$
0.790	0.0352	"
1.490	0.0268	"
2.365	0.0191	"
3.38	0.0139	"

CO

SOLUBILITY OF POTASSIUM CARBONATE IN AQUEOUS SOLUTIONS
OF SODIUM CARBONATE AND VICE VERSA AT SEVERAL TEMPERATURES.
(Hjinsky, 1924.)

Gms. per 100 gms. H ₂ O.		Solid Phase.	d. of sat. sol.	Gms. per 100 gms. H ₂ O.		Solid Phase
K ₂ CO ₃ .	Na ₂ CO ₃ .			K ₂ CO ₃ .	Na ₂ CO ₃ .	
Results at -6°.						
84.4	0.0	K ₂ CO ₃ .2H ₂ O	—	24.3	16.3	K ₂ CO ₃ .Na ₂ CO ₃ .6H ₂ O
54.0	6.9	" + K ₂ CO ₃ .Na ₂ CO ₃ .10H ₂ O	—	24.0	18.0	" + Na ₂ CO ₃ .10H ₂ O
38.1	6.7	K ₂ CO ₃ .Na ₂ CO ₃ .10H ₂ O	—	15.0	15.4	"
25.4	11.7	" + Na ₂ CO ₃ .10H ₂ O	—	0.0	28.5	"
Results at +10°.						
108.4	0.0	K ₂ CO ₃ .2H ₂ O	1.558	119.3	0.0	K ₂ CO ₃ .H ₂ O
105.3	6.1	K ₂ CO ₃ .Na ₂ CO ₃ .6H ₂ O	1.556	110.0	8.4	"
50.0	10.8	"	—	107.0	11.3	" + K ₂ CO ₃ .Na ₂ CO ₃ .6H ₂ O
35.4	17.6	Na ₂ CO ₃ .10H ₂ O	1.544	101.0	11.3	K ₂ CO ₃ .Na ₂ CO ₃ .6H ₂ O
0.0	12.0	"	1.527	87.0	16.3	"
Results at 24°-2.						
			1.500	82.6	16.2	"
112.6	0.0	K ₂ CO ₃ .2H ₂ O	1.445	48.0	27.2	"
110.1	2.5	"	1.400	32.2	33.4	"
108.5	9.5	"	1.389	26.7	35.5	"
107.4	11.2	" + K ₂ CO ₃ .Na ₂ CO ₃ .6H ₂ O	1.385	25.9	35.7	"
98.3	13.8	K ₂ CO ₃ .Na ₂ CO ₃ .6H ₂ O	1.381	23.8	36.5	"
92.1	13.0	"	—	21.0	41.0	" + Na ₂ CO ₃ .H ₂ O
48.4	18.7	"	1.356	15.3	43.4	Na ₂ CO ₃ .H ₂ O
34.5	27.4	"	1.360	10.0	44.6	"
28.3	33.1	"	—	0.0	49.0	"

Additional determinations upon this system are given by Kremann and Zitek, 1909, and by Osaka, 1910-11. These authors in common with Iljinski, 1924, report the formation of a hydrated double carbonate of potassium and sodium. The following later very careful determinations of Hill and Miller, Jr., 1927, show that at no temperature between 20° and 50° is a hydrated double carbonate formed, but that the material which exists in contact with the saturated solutions is a hydrated solid solution, the composition of which can vary over a considerable range. Due to the slowness with which equilibrium is reached, in all cases in which solid solution is formed, the authors found it necessary to prepare the mixtures in a special manner which would reduce the length of time required for attainment of the internal equilibrium of the solid solution or anhydrous double compound. The saturated solutions were analyzed by evaporation to dryness and estimation of the H_2O by loss in weight. The total carbonates were determined by titration and from this result and the known weight of the mixed carbonates the percentage of each was calculated. The results are recorded in percentage of H_2O and Na_2CO_3 . In the following table the K_2CO_3 values have been obtained by subtracting the sum of $H_2O + Na_2SO_4$ from 100.

d. of sat. sol.	Gms. per 100 gms. sat. sol.		Solid Phase	d. of sat. sol.	Gms. per 100 gms. sat. sol.		Solid Phase
	K_2CO_3	Na_2CO_3			K_2CO_3	Na_2CO_3	
Results at 20°				Results at 25° (con.)			
—	52.6	0.0	K.1½	1.368	10.1	24.3°	N.7
—	49.9	3.0	" + S	1.369	9.3	24.3°	"
1.545	49.0	3.6	S	1.335	4.4	26.1°	"
1.541	48.2	3.6	"	1.317	10.8	22.9	N.10
1.417	43.6	7.6	"	—	6.1	22.0	"
1.373	17.4	19.0	"	1.263	2.6	22.4	"
1.375	15.3	21.1°	"	—	0.0	22.5	"
1.372	13.9	22.5°	"	Results at 30°			
1.371	17.2	19.2	" + N.10	—	53.2	0.0	K.1½
1.352	16.0	18.7	N.10	1.561	50.2	3.5	"
—	0.0	17.8	"	1.561	49.9	4.0	" + KN
Results at 25°				1.554	49.0	4.7	KN
—	52.8	0.0	K.1½	1.558	48.0	5.4	"
1.561	51.5	2.8	"	1.553	47.9	5.3	"
1.555	48.4	5.0	" + S	1.551	46.2	6.6	"
1.551	47.5	4.9	S	1.547	45.8	6.8	" + N.1
1.552	45.7	5.3	"	1.545	45.1	7.3	N.1
—	39.4	6.4	"	1.543	44.85	7.3	N.1 + S
—	37.1	7.2	"	1.530	44.1	7.3	S
1.471	29.5	11.6	"	1.451	33.4	11.1	"
1.471	26.5	13.6	"	1.422	23.0	18.5	"
1.406	26.2	13.7	"	1.419	22.1	19.1	" + N.1
1.404	21.0	17.9	"	1.414	21.2	19.6	N.1
1.399	16.4	22.1	"	1.398	16.2	22.6	"
1.395	15.8	22.7	" + N.7	1.390	13.5	24.5	"
—	14.1	23.2	N.7	1.378	10.2	26.6	" + N.7
1.404	12.6	23.3	"	1.354	6.7	27.8	N.7
1.368	12.5	23.3	" + N.10	1.330	4.0	28.6	" + N.10
				—	0.0	28.0	N.10

K.1½ = $K_2CO_3 \cdot 1\frac{1}{2}H_2O$; S = Solid Solution $(Na_2, K_2)CO_3 \cdot 6H_2O$, the mol. ratio $K_2CO_3 : Na_2CO_3$ varies from 1:0.88 to 1:2.07; N.10 = $Na_2CO_3 \cdot 10H_2O$; N.7 = $Na_2CO_3 \cdot 7H_2O$; N.1 = $Na_2CO_3 \cdot H_2O$; KN = $K_2CO_3 \cdot Na_2CO_3$.

SOLUBILITY OF POTASSIUM CARBONATE IN AQUEOUS SOLUTIONS OF
SODIUM CARBONATE AND VICE VERSA AT VARIOUS TEMPERATURES (Con.).
(Olin and Miller, *ibid.*, 1927.)

d. of sat. sol.	Gms. per 100 gms. K_2CO_3	gms. sat. sol. Na_2CO_3	Solids Phase	d. of sat. sol.	Gms. per 100 gms. K_2CO_3	gms. sat. sol. Na_2CO_3	Solids Phase
Results at 15°				Results at 40°			
—	53.2	0.0	K.14	—	51.6	0.0	K.1
—	49.8	4.1	" + KN	—	50.9	3.5	"
1.555	47.5	5.7	KN	1.545	50.4	4.0	"
—	45.1	6.7	" + N.1	1.552	48.7	4.9	KN
1.510	40.7	8.9	N.1	—	46.5	5.7	"
1.498	38.0	10.0	"	1.512	44.4	7.2	"
1.479	37.0	10.6	" + S	1.504	42.5	9.6	N.1
1.454	35.5	11.5	S	1.461	42.4	12.9	"
1.455	34.2	12.0	"	1.421	41.4	18.2	"
1.454	32.9	12.8	" + N.1	1.492	42.6	21.5	"
1.457	30.6	14.0	N.1	—	0.0	44.2	"
1.440	27.8	15.0	"	Results at 50°			
1.377	13.8	24.0	"	—	54.4	0.0	K.1
1.354	4.7	29.9	" + N.7	1.574	52.4	3.4	"
—	0.0	31.6	N.7	1.540	44.5	8.0	KN
				1.521	42.6	8.5	N.1
				—	0.0	42.2	"

CO

K.14 = $K_2CO_3 \cdot 14H_2O$; S = Solid Solution ($Na_2CO_3 \cdot 6H_2O$), the mol. ratio $K_2CO_3 : Na_2CO_3$ varies from 1:0.88 to 1:2.07; K.10 = $Na_2CO_3 \cdot 10H_2O$; N.7 = $Na_2CO_3 \cdot 7H_2O$; N.1 = $Na_2CO_3 \cdot H_2O$; KN = $K_2CO_3 \cdot Na_2CO_3$.

Results for the quintuple points are also given.

SOLUBILITY OF POTASSIUM CARBONATE IN AQUEOUS SOLUTIONS OF
SODIUM CARBONATE AND VICE VERSA AT 40°.
(Olin, 1927.)

Great care was exercised in securing equilibrium. The combined potassium and sodium was determined by weighing as chlorides. The potassium was determined as perchlorate. The existence of $Na_2CO_3 \cdot 10H_2O$ was demonstrated and its transition point to $Na_2CO_3 \cdot H_2O$ found to be 49.8°.

d. of sat. sol.	Gms. per 100 gms. K_2CO_3	gms. sat. sol. Na_2CO_3	Solids Phase	d. of sat. sol.	Gms. per 100 gms. K_2CO_3	gms. sat. sol. Na_2CO_3	Solids Phase
—	53.9	0.0	K.14	1.497	21.6	17.8	N.1
1.582	51.9	2.7	"	1.487	12.9	24.9	"
1.581	50.7	3.8	" + KN	1.474	9.4	26.6	N.1
1.586	48.1	5.6	KN	1.466	6.2	28.5	"
1.563	45.8	6.8	"	1.461	12.2	21.6	N.1
1.562	44.4	7.2	" + N.1	1.441	5.4	19.0	"
1.550	42.8	7.2	N.1	1.494	7.4	21.6	"
1.508	37.1	9.5	"	1.494	6.6	22.5	"
1.496	31.1	13.6	"	1.472	4.8	22.1	"
1.451	27.1	15.5	"	1.492	4.9	22.8	"
1.424	24.3	16.7	"	1.428	2.4	40.0	"
				1.426	1.8	44.4	"
				—	0.0	42.8	"

K.14 = $K_2CO_3 \cdot 14H_2O$; KN = $K_2CO_3 \cdot Na_2CO_3$; N.1 = $Na_2CO_3 \cdot H_2O$; N.3 = $Na_2CO_3 \cdot 3H_2O$.

POTASSIUM CARBONATE

Data for equilibrium in the system,
 $K_2CO_3 + 2NaHCO_3 \rightleftharpoons 2KHCO_3 + Na_2CO_3$ in water at 25°, are given by Hill and Smith, 1929.

The authors first give the previously determined data for the four 3 component systems; $K_2CO_3 + Na_2CO_3 + H_2O$, $K_2CO_3 + KHCO_3 + H_2O$, $KHCO_3 + NaHCO_3 + H_2O$ and $Na_2CO_3 + NaHCO_3 + H_2O$, calculated to gram mols. per 1000 gm. mols. H_2O . They then report their results for saturated solutions each composed of water and three of the above four compounds-and in contact with two or three of the several solid phases which exist at 25°. The results show the location of 14 curves representing the solubility equilibrium existing with two solid phases, and of seven isothermal invariant points at which the solution is in equilibrium with 3 solid phases. A new tetragene salt was found, having the formula $K_2CO_3 \cdot NaHCO_3 \cdot 2H_2O$ and not occurring in any of the 3 component systems.

In a later paper Hill, 1930 gives results for double salt formation among the carbonates and bicarbonates of potassium and sodium at 25° and at 35°. The partial isotherms show that the double salt $K_2CO_3 \cdot 2KHCO_3 \cdot 1\frac{1}{2}H_2O$ and the tetragone salt $K_2CO_3 \cdot NaHCO_3 \cdot 2H_2O$ both exist at these two temperatures.

POTASSIUM Bi CARBONATE

SOLUBILITY OF POTASSIUM BICARBONATE IN AQUEOUS
 SOLUTIONS OF SODIUM BICARBONATE AND VICE VERSA.
 (Oglesby, 1929.)

Carbon dioxide was bubbled through the solutions prior to the period of saturation and afterwards an atmosphere of CO_2 was maintained above the surface of the solutions. The analyses were made by titrating the total alkali with HCl and determining the K by the perchloric acid method.

d. of sat. sol.	Gms. per 100 NaHCO ₃	gms. sat. sol. KHCO ₃	Solid Phase	d. of sat. sol.	Gms. per 100 NaHCO ₃	gms. sat. sol. KHCO ₃	Solid Phase
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Results at 20°

1.1777	0.00	24.98	KHCO ₃
1.1830	1.38	24.32	"
1.1897	2.84	23.58	"
1.1966	4.37	22.89	" + NaHCO ₃
1.1803	4.58	20.48	NaHCO ₃
1.1637	4.88	17.98	"
1.1519	5.16	16.15	"
1.1309	5.73	12.72	"
1.0954	7.05	6.45	"
1.0625	8.72	0.00	"

Results at 25° (Con.)

1.1903	4.94	21.89	NaHCO ₃
1.1732	5.14	19.39	"
1.1547	5.62	16.46	"
1.1282	6.38	12.10	"
1.1035	7.41	7.63	"
1.0857	8.20	4.23	"
1.0648	9.34	0.00	"

Results at 30°

1.1988	0.0	28.52	KHCO ₃
1.2077	2.06	27.43	"
1.2145	3.58	26.66	"
1.2189	4.83	26.01	" + NaHCO ₃
1.1887	5.47	21.40	NaHCO ₃
1.1543	6.23	16.08	"
1.1196	7.34	10.22	"
1.0973	8.22	6.18	"
1.0673	9.95	0.0	"

Results at 25°

1.1882	0.00	26.78	KHCO ₃
1.1927	1.12	26.13	"
1.1977	2.39	25.56	"
1.1998	2.72	25.27	"
1.2042	3.74	24.93	"
1.2087	4.63	24.46	" + NaHCO ₃

EQUILIBRIUM IN THE SYSTEM POTASSIUM CARBONATE, SODIUM CARBONATE, POTASSIUM SULFATE, SODIUM SULFATE AND WATER AT 25°.

(Blasdale, 1923.)

Gms. per 100 gms. H ₂ O.				Solid Phase.
K ₂ CO ₃ .	Na ₂ CO ₃ .	K ₂ SO ₄ .	Na ₂ SO ₄ .	
0.0	27.44	0.0	24.06	Na ₂ CO ₃ · 10H ₂ O + Na ₂ SO ₄ · 10H ₂ O
0.0	0.0	9.34	30.98	K ₂ Na ₂ SO ₄ · "
0.0	0.0	13.31	6.86	" + K ₂ SO ₄
3.58	26.09	0.0	25.46	" + Na ₂ CO ₃ · 10H ₂ O + Na ₂ SO ₄ · 10H ₂ O
7.37	33.74	6.30	0.0	" " " + K ₂ SO ₄
18.50	35.63	1.45	0.0	Na ₂ CO ₃ · 7H ₂ O " " "
27.07	35.35	0.0	1.01	" " KNaCO ₃ · 6H ₂ O " "
103.72	10.83	1.36	0.0	K ₂ CO ₃ · 7H ₂ O " " "
35.71	27.38	0.97	0.0	KNaCO ₃ · 6H ₂ O + K ₂ SO ₄
0.0	41.65	9.40	3.31	Na ₂ CO ₃ · 10H ₂ O + K ₂ Na(SO ₄) ₂

100 gms. Aq. 86.5% Glycerol ($d = 1.2326$) dissolve 40.5 gms. K₂CO₃ at 20°.
 " 98.5% " ($d = 1.2645$) " 39.4 " " " (Holm, 1921-1922.)

CO

EQUILIBRIUM IN THE SYSTEM POTASSIUM CARBONATE, METHYL ALCOHOL, WATER AT 23°-26°.

(Frankforter and Frary, 1913.)

The authors give the data for the binodal curve and the quadruple points but tie lines, other than for the quadruple points, were not determined.

Gms. per 100 Gms. Homogeneous Liquid.			Gms. per 100 Gms. Homogeneous Liquid.		
K ₂ CO ₃ .	CH ₃ OH.	H ₂ O.	K ₂ CO ₃ .	CH ₃ OH.	H ₂ O.
6.32	75.85	17.83*	21.61	33.43	44.96
6.91	63.13	29.97	23.15	31.26	45.60
8.07	59.26	32.67	28.25	23.82	47.94
10.17	52.64	35.33	30.72	20.57	48.71
12.03	49.97	37.99	32.92	17.27	49.80
14.24	45.74	40.02	40.65	9.26	50.09
16.48	41.76	41.76	43.95	6.96	49.09
18.89	37.76	43.36	45.89	6.42	47.69
			49.05	6.1	44.88†

* Upper quad. point.

† Lower quad. point.

The following results for the solubility of K₂CO₃ in concentrations of aq. CH₃OH above and below those yielding liquid layers are also given.

Gms. per 100 Gms. Sat. Sol.		Gms. per 100 Gms. Sat. Sol.	
CH ₃ OH.	K ₂ CO ₃ .	CH ₃ OH.	K ₂ CO ₃ .
1.03	51.39	85	2.05
2.22	50.33	89.2	1.56
6.1	49.05 (Lower quad. pt.)	91	1.98
Two Liquid Layers Formed Here.		93.6	2.72
75.85	6.32 (Upper quad pt.)	94.3	5.7 (Abs. CH ₃ OH).

Data for the binodal curves for this system at 17° and at 35° are given by de Bruyn (1900).

This author also gives the following data for the composition of the conjugated liquids in equilibrium with solid potassium carbonate (quadruple points) at various temperatures.

t°.	Gms. per 100 Gms. Upper Layer.			Gms. per 100 Gms. Lower Layer.		
	K ₂ CO ₃ .	CH ₃ OH.	H ₂ O.	K ₂ CO ₃ .	CH ₃ OH.	H ₂ O.
-30	21.7	42.2	36.1	...	...	...
-20	13.8	52.1	34.1	...	...	...
-20	12.4	...	...	44.2	8.2	47.6
0	7.6	66.3	26.1	46.3	6.7	47
0	7.4	...	...	46.6	6.6	46.8
+17	6.2	69.6	24.2	48.3	5.7	46
35	5	72.9	22.1	51	4.3	44.7

EQUILIBRIUM IN THE SYSTEM POTASSIUM CARBONATE, POTASSIUM DIPROPYL MALONATE AND WATER AT 25°.
(M'David, 1909-10.)

A series of mixtures of K₂CO₃ + KC₁₁H₁₉O₄ + H₂O were prepared and thoroughly mixed. They were placed in a thermostat at 25° and the two layers which separated in each case, were analyzed.

Gms. per 100 Gms. Upper Layer.			Gms. per 100 Gms. Lower Layer.		
K ₂ CO ₃ .	KC ₁₁ H ₁₉ O ₄ .	H ₂ O.	K ₂ CO ₃ .	KC ₁₁ H ₁₉ O ₄ .	H ₂ O.
4.05	65.1	30.85	42.6	0.4	57
4.9	59.8	35.3	40.7	0.4	58.9
5.6	53.5	40.9	35	0.5	64.5
7.2	50.5	42.3	33.5	0.9	65.6
8.7	39.2	52.1	28.9	0.7	70.4
11	34.6	54.4	26.8	0.8	72.4
14.5	23.5	62	24.8	3	72.2
17	18.6	64.4	23.1	6.05	70.85
18.6	15	66.4	21.7	8.7	69.6

Several determinations at 2° and at 56° are also given.

EQUILIBRIUM IN THE SYSTEM POTASSIUM CARBONATE, ETHYL ALCOHOL AND WATER AT 23°-26°. (Frankforter and Frary, 1913.)

NOTE.—The binodal curve for the system was very carefully determined and tie lines were located by estimations of K₂CO₃ in specially prepared conjugated liquids. The original results have been plotted and the following data for the conjugated layers read from the curve:

Alcohol Rich Layer (Upper)			Water Rich Layer (Lower.)		
Gms. per 100 Gms. Solution.			Gms. per 100 Gms. Solution.		
K ₂ CO ₃ .	C ₂ H ₅ OH.	H ₂ O.	K ₂ CO ₃ .	C ₂ H ₅ .	H ₂ O.
0.095	90.65	9.255†	53.6	0.28	46.12†
0.241	72.7	27.059	39.11	1	50.89
1.72	53.5	44.78	29.62	4	66.38
4.03	42.6	53.37	25.7	6.4	67.9
6.30	35.5	58.2	21.08	11	67.92
8.29	31	60.71	19.15	13.2	67.65
10.35	27	62.65	18.18	14.7	67.12
14.2	20.5	65.3	14.2	20.5	65.3*

* Plait point.

† Quad. point.

The authors give a complete summary of previous investigations of this system by de Bruyn (1899, 1900); Bell (1905); Cuno (1908-09).

Data for the conjugated liquid layers obtained in the system potassium carbonate, ethyl alcohol and water at 17° and at 35° are given by de Bruyn (1900) and at 20°, 40° and 60° by Cuno (1908).

COMPOSITION OF THE CONJUGATED LIQUIDS WHICH ARE IN EQUILIBRIUM WITH SOLID POTASSIUM CARBONATE (QUADRUPLE POINTS) AT VARIOUS TEMPERATURES.

(de Bruyn, 1900.)

t°.	Gms. per 100 Gms. Upper Layer.			Gms. per 100 Gms. Lower Layer.		
	K ₂ CO ₃	C ₂ H ₅ OH	H ₂ O	K ₂ CO ₃	C ₂ H ₅ OH	H ₂ O
-18	0.03	90.3	9.7	51.2	0.2	48.6
0	0.04	91.0	8.1	51.3	0.2	48.5
+17	0.06	91.5	8.4	52.1	0.2	47.7
35	0.07	90.0	9	53.4	0.2	46.4
50	0.09	91.8	8.1	55.3	0.2	44.5
75	0.12	91.4	8.5	57.0	0.2	41.0

EQUILIBRIUM IN THE SYSTEM POTASSIUM CARBONATE, ACETONE, WATER AT 20°.
(Frankforter and Cohen, 1914.)

The binodal curve was very carefully determined and, in addition, data for the quadruple points (solid K₂CO₃) and five tie lines were located. These data were plotted and the following interpolated values for the conjugated liquids read from the curve.

CO

Gms. per 100 Gms. Upper Layer.			Gms. per 100 Gms. Lower Layer.		
K ₂ CO ₃	(CH ₃) ₂ CO	H ₂ O	K ₂ CO ₃	(CH ₃) ₂ CO	H ₂ O
0.0024	96.4	3.58†	52.4	100	47.6†
0.039	94	35.96	32.64	1.2	66.17
0.712	55.3	43.99	24.4	3.7	71.9
1.36	48.5	50.14	22.91	4.7	72.30
4.57	34	61.43	16.92	10.2	72.88
6.97	27.5	65.83	14.77	13	72.23
10.5	20	69.5*	10.8	20	69.5

* Plat point.

† Quad. points.

Additional results for the binodal curve at 20°-30°, agreeing satisfactorily with the above, are given by Leeming, 1925 (21). This author mentions that the effect of temperature upon the results is slight.

EQUILIBRIUM IN THE SYSTEM POTASSIUM CARBONATE, NORMAL PROPYL ALCOHOL AND WATER AT 22°-26°.
(Frankforter and Fratz, 1914.)

The authors give the data for the binodal curve and the quadruple points but tie lines were not located.

Gms. per 100 Gms. Homogeneous Liquid.			Gms. per 100 Gms. Homogeneous Liquid.		
K ₂ CO ₃	C ₃ H ₇ OH	H ₂ O	K ₂ CO ₃	C ₃ H ₇ OH	H ₂ O
52.9	0.02	47.08*	7.45	9.39	83.25
46.98	0.12	52.91	5.97	11.92	82.06
39	0.20	60.80	4.73	12.71	82.56
34.58	0.20	65.15	3.86	14.60	81.54
30.43	0.45	69.12	3.11	17.17	79.71
26.51	0.78	72.71	2.42	24.71	72.87
22.81	1.32	75.87	1.91	34.99	63.10
19.08	2.31	78.62	1.71	39	59.20
16.35	3.24	80.41	1.33	45.57	53.09
13.47	4.41	82.12	0.948	54.56	47.49
10.90	6.24	82.77	0.487	64.20	35.41
8.55	8.31	83.14	0.017	95.83	4.153†

* Lower quad. point.

† Upper quad. point

EQUILIBRIUM IN THE SYSTEM POTASSIUM CARBONATE, ISOPROPYL ALCOHOL
AND WATER AT 20°.

(Frankforter and Temple, 1915.)

NOTE. — The results for the binodal curve in this and the following system are reported in terms of gms. per 100 gms. solvent (water + alcohol) instead of gms. per 100 gms. of homogeneous liquid (K_2CO_3 + water + alcohol.)

Gms. per 100 Gms. Alcohol + Water.			Gms. per 100 Gms. Alcohol + Water.		
K_2CO_3 .	Alcohol.	Water.	K_2CO_3 .	Alcohol.	Water.
44.844	2.911	97.089	15.021	19.445	80.555
36.137	4.783	95.217	13.244	23.919	76.081
28.879	7.349	92.651	6.065	45.397	54.603
24.152	9.159	90.841	3.933	53.265	46.735
17.665	14.395	85.605	2.954	57.294	42.706

EQUILIBRIUM IN THE SYSTEM POTASSIUM CARBONATE
ISO PROPYL ALCOHOL AND WATER AT 25°.

(Ginnings and Chen, 1931.)

The binodal curve, a tie line and the plait point were carefully determined.

Gms. per 100 gms. of the three constituents		Gms. per 100 gms. of the three constituents	
K_2CO_3	$CH_3CHOHCH_3$	K_2CO_3	$CH_3CHOHCH_3$
0.10	69.60*	13.86	10.10
2.80	42.20	19.83	4.42
6.04	28.40	25.50	1.93
6.2	27.8 PP	33.20	0.65
9.65	17.25	52.67	0.23*

* Tie line which shows the composition of each of two liquid layers in contact with each other. The one being the upper, rich in iso propyl alcohol and the other, the lower, rich in K_2CO_3 .

PP is the plait point which shows the composition at that point on the binodal curve where the two layers merge into a homogeneous liquid.

EQUILIBRIUM IN THE SYSTEM POTASSIUM CARBONATE, ALLYL ALCOHOL AND
WATER AT 20°.

(Frankforter and Temple, 1915.)

Gms. per 100 Gms. Alcohol + Water.			Gms. per 100 Gms. Alcohol + Water.		
K_2CO_3 .	Alcohol.	Water.	K_2CO_3 .	Alcohol.	Water.
47.746	2.103	97.897	8.239	30.677	69.323
33.200	5.267	94.733	5.521	39.337	60.663
23.486	9.309	90.691	2.020	54.487	45.513
16.354	15.037	84.963	1.015	62.610	37.390
11.331	22.454	77.540	0.0853	81.228	18.772

The binodal curve for this system at 25° has also been determined by Ginnings and Dees, 1935, but the authors do not give their experimental results but only a series of arbitrary constants calculated from them by means of an empirical equation. From these the conclusion is drawn that allyl alcohol seems to be more difficult to salt out than either iso propyl or normal propyl alcohol.

EQUILIBRIUM IN THE SYSTEM POTASSIUM CARBONATE, TERTIARY
BUTYL ALCOHOL AND WATER AT 30°.

(Ginnings and Robbins, 1930.)

The points on the binodal curve were determined by observing the appearance or disappearance of clouding in a mixture of weighed amounts of salt and one of the liquids, upon addition of a weighed amount of the other. The conjugated points were found by preparing mixtures which yielded two liquid layers and analyzing each for salt content. The plait point, P.P., was found by plotting. The following results are those given in the authors' table under the column heading K_2SO_4 which was evidently intended for K_2CO_3 .

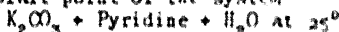
Gms. per 100 gms. $K_2CO_3 + (CH_3)_3COH + H_2O$ $K_2CO_3 \quad (CH_3)_3COH$		Gms. per 100 gms. $K_2CO_3 + (CH_3)_3COH + H_2O$ $K_2CO_3 \quad (CH_3)_3COH$		Conjugation Point Data	
				Wt. percent $(CH_3)_3COH$ in butanol rich phase	Wt. percent K_2CO_3 in salt rich phase
0.7	57.8	9.8	9.1	69	34.2
1.8	39.3	11.4	7.5	62	24.7
3.1	26.9	13.3	5.9	53	14.8
4.8	18.9	15.4	4.5	27	3.2 P.P.
5.1	17.7	17.0	3.5		
5.8	16.1	26.7	0.9		
7.2	12.8	34.2	0.4		

CO

In a later paper by Ginnings, Herring and Webb, 1933, the values given for the plait point, P.P., are respectively,

2.3 percent K_2CO_3 and 36.3 percent $(CH_3)_3COH$ instead of 3.2 and 2.7 as shown above.

The binodal curve and plait point of the system



has been determined by Ginnings, Webb and Hinohara, 1933., but the authors do not give their experimental results but only the values of a series of constants calculated from them by means of empirical equations.

Data for equilibrium in the system composed of



are given by Goldblum and Stoffella, 1910.

100 cc. anhydrous hydrazine dissolve 1 gm. K_2CO_3 at room temp.

(Welsh and Broderson, 1915.)

100 gms. aqueous solution simultaneously sat. with K_2CO_3 and cane sugar at 31.25° contain 22.24 gms. K_2CO_3 and 56 gms. sugar.

(Köhler, 1897.)

Freezing-point data for mixtures of $K_2CO_3 + KCl$ and $K_2CO_3 + NaCl$ (Sackur, 1911-12). $K_2CO_3 + K_2SO_4$ (Amadori, 1912; Le Chatelier, 1894); $K_2CO_3 + Na_2CO_3$ (Le Chatelier, 1894).

(Le Chatelier, 1894.)

POTASSIUM URANYL CARBONATE $2K_2CO_3 \cdot (UO_2)_2CO_3$.

100 gms. H_2O dissolve 7.4 gms. salt at 15°.

(Ebelmen, 1852.)

POTASSIUM OXALATE $K_2C_2O_4 \cdot H_2O$.

FREEZING-POINTS OF AQUEOUS SOLUTIONS OF POTASSIUM OXALATE.

(Klein and Svanberg, 1920.)

t°	—0.146.	—1.066.	—2.088.
Gms. $K_2C_2O_4$ per 100 cc. solution	1.271	4.177	8.355

SOLUBILITY OF POTASSIUM OXALATE IN WATER. (Woskressenskaja, 1926.)

Saturation was secured by constant stirring for 2 to 4 hours, and repeating the determinations after stirring another $1\frac{1}{2}$ hours. Below 0° the determinations were made by the freezing-point method.

t° .	Gms. $K_2C_2O_4$ per 100 gms. sat. sol.	Solid Phase.	t° .	Gms. $K_2C_2O_4$ per 100 gms. sat. sol.	Solid Phase.
— 0.0.....	0.0	Ice	20.....	25.95 (23.89)	$K_2C_2O_4 \cdot H_2O$
— 0.6.....	2.4	»	25.....	27.40	»
— 1.4.....	5.14	»	30.....	28.70	»
— 3.0.....	10.47	»	40.....	31.2	»
— 4.0.....	14.10	»	50.....	33.5	»
— 5.05.....	17.12	»	60.....	35.6	»
— 5.75.....	18.83	»	70.....	37.8	»
— 6.34 Eutec.	20.00	$\gg + K_2C_2O_4 \cdot H_2O$	80.....	40.2	»
\pm 0.....	20.28	$K_2C_2O_4 \cdot H_2O$	90.....	42.0	»
10.....	23.20	»	100.....	44.5	»
16.....	24.81	»	107.....	45.9	»

The result in parenthesis is given by Trifonov, 1924, 1925.

SOLUBILITY OF MIXTURES OF POTASSIUM OXALATE AND OXALIC ACID IN WATER AT 25° .

(Foote and Andrew, 1905.)

Gms. per 100 Gms. Solution.		Mols. per 100 Mols. H_2O .		Solid Phase.
$H_2C_2O_4$.	$K_2C_2O_4$.	$H_2C_2O_4$.	$K_2C_2O_4$.	
10.2	...	2.274	...	$H_2C_2O_4 \cdot 2H_2O$
10.31	0.04	2.302	0.005	$H_2C_2O_4 \cdot 2H_2O + H_3K(C_2O_4)_2 \cdot 2H_2O$
9.26	0.13	2.046	0.016	} Double salt $H_3K(C_2O_4)_2 \cdot 2H_2O$
3.39	0.63	0.707	0.071	
2.06	4.26	0.440	0.495	$H_3K(C_2O_4)_2 \cdot 2H_2O + HKC_2O_4$
1.16	11.50	0.266	1.427	} Double salt HKC_2O_4
0.99	16.93	0.240	2.235	
0.85	21.08	0.221	2.928	$HKC_2O_4 + H_3K_4(C_2O_4)_3 \cdot 2H_2O$
0.82	21.49	0.211	2.998	} Double salt $H_3K_4(C_2O_4)_3 \cdot 2H_2O$
0.64	23.52	0.169	3.361	
0.57	24.88	0.153	3.617	
0.43	27.52	0.122	4.14	$H_3K_4(C_2O_4)_3 \cdot 2H_2O + K_3C_7O_4 \cdot H_2O$
...	27.40	...	4.09	$K_3C_7O_4 \cdot H_2O$

SOLUBILITY OF POTASSIUM TETROXALATE, $KH_3(C_2O_4)_2 \cdot 2H_2O$, IN WATER.

(Koppel and Cahn, 1908.)

t° .	Gms. $KH_3(C_2O_4)_2$ per 100 Gms. H_2O .	Solid Phase.
—0.25 cryohydrate	0.99	$KH_3(C_2O_4)_2 \cdot 2H_2O$
0	1.27	»
30	4.30	»
60	11.95	»
103.5 b. pt.	72.17	»
100 gms. methyl alcohol dissolve 2.07 gms. $KH_3(C_2O_4)_2$ at 15° and		
1.55 gms. at the b. pt., 66.4° .		
100 gms. acetone dissolve 2.44 gms. $KH(C_2O_4)_2$ at 15° . (Henstock, 1934.)		

EQUILIBRIUM IN THE SYSTEM POTASSIUM OXALATE, OXALIC ACID, WATER AT
0°, 30° AND 60°.
(Koppel and Cahn, 1908.)

Results at 0°.		Results at 30°.		Results at 60°.		Solid Phase in Each Case.
Gms. per 100 Gms. Sat. Sol.		Gms. per 100 Gms. Sat. Sol.		Gms. per 100 Gms. Sat. Sol.		
C ₂ O ₄ .	K ₂ O.	C ₂ O ₄ .	K ₂ O.	C ₂ O ₄ .	K ₂ O.	
2.72	...	0.97	...	24.75	...	H ₂ C ₂ O ₄ ·2H ₂ O
2.91	0.226*	10.15	0.10	...	...	"
2.985	0.342*	...	...	...	...	"
2.827	0.125	10.23	0.34	25.70	0.46	" + KH ₂ (C ₂ O ₄) ₂ ·2H ₂ O
2.345	0.145	...	...	...	...	"
1.471	0.195	7.28	0.33	25.80	0.54	KH ₂ (C ₂ O ₄) ₂ ·2H ₂ O
0.823	0.240	4	0.41	22.00	0.58	"
0.799	0.454	3.08	0.50	20.17	0.67	"
1.173	0.785	2.38	1.00	14.25	0.90	"
1.381	0.062	2.98	1.79	9.82	1.48	"
1.545	1.155	...	...	6.95	2.244	"
1.666	1.273	4.24	2.76	9.17	5.60	" + KH ₂ CO ₃
1.754	1.470	4.26	3.38	8.81	6.37	KHC ₂ O ₄
2.627	2.858	5.44	5.43	10.17	10	"
3.772	4.422	6.66	7.27	12.36	13.40	"
4.202	5.161	8.64	10.05	14.10	16	"
4.975	6.088	10.03	12.01	15.35	17.80	"
5.652	7	10.80	12.04	16.07	18.80	" + K ₂ C ₂ O ₄ ·H ₂ C ₂ O ₄ ·2H ₂ O
6.27	7.87	11.47	14.13	16.51	19.59	(K ₂ C ₂ O ₄ ·H ₂ C ₂ O ₄)·2H ₂ O
7.63	9.72	12.16	15.11	16.80	20.10	"
8.66	11.14	12.32	15.37	16.95	20.31	"
0.055	11.58	12.00	16.23	17.14	20.70	" + K ₂ C ₂ O ₄ ·H ₂ O
8.826	11.52	12.36	16.14	16.71	20.41	K ₂ C ₂ O ₄ ·H ₂ O
5.215	12.33	8.52	15.03	15.94	20.11	"
2.23	14.80	4.53	15.55	15.06	19.66	"
1.245	16.82	1.87	18.17	8.82	19.25	"
0.871	18.4	0.74	22.32	2.04	23.09	"
0.511	20.91	...	...	0.434	29	"
0.325	23.30	...	...	0.365	31.40	"
0	41.3†	0	46.79	0	51.34	KOH·H ₂ O

* Supersaturated.

† About.

EQUILIBRIUM IN THE SYSTEM POTASSIUM OXALATE, OXALIC ACID, WATER
AT 25°.

(Hartley, Drugman, Vlieland and Bourdillon, 1900.)

Gms. per 100 Gms. Sat. Sol.		Solid Phase.	Gms. per 100 Gms. Sat. Sol.		Solid Phase.
C ₂ O ₄ .	K ₂ O.		C ₂ O ₄ .	K ₂ O.	
8.29	0	H ₂ C ₂ O ₄ ·2H ₂ O	3.079	2.052	KH ₂ (C ₂ O ₄) ₂ ·2H ₂ O
8.278	0.045	" + KH ₂ (C ₂ O ₄) ₂ ·2H ₂ O	3.450	2.360	" + KHC ₂ O ₄
7.412	0.064	KH ₂ (C ₂ O ₄) ₂ ·2H ₂ O	3.793	3.100	KHC ₂ O ₄
2.827	0.238	"	5.457	5.019	"
2.007	0.346	"	9.816	11.96	" + 4K ₂ C ₂ O ₄ ·H ₂ C ₂ O ₄ ·H ₂ O
1.734	0.567	"	12.365	15.71	2K ₂ C ₂ O ₄ ·H ₂ C ₂ O ₄ ·2H ₂ O + K ₂ C ₂ O ₄ ·H ₂ O
2.675	1.714	"	11.85	15.51	K ₂ C ₂ O ₄ ·H ₂ O

Similar data at 15° for the above system are given by Jungfleisch and Landrieu (1914a).

SOLUBILITIES IN THE SYSTEM POTASSIUM OXALATE, OXALIC ACID, WATER AT THE CRYOHYDRIC POINTS.

(Koppel and Cahn, 1908.)

(Temp. of Equilibrium of Solution with Ice.)

t° of Ice Separation.	Gms. per 100 Gms. Sat. Sol.		Solid Phase, Ice +:	t° of Ice Separation.	Gms. per 100 Gms. Sat. Sol.		Solid Phase, Ice +:
	C ₂ O ₃ .	K ₂ O.			C ₂ O ₃ .	K ₂ O.	
-0.95	2.641	...	H ₂ C ₂ O ₄ .2H ₂ O	-4.45	6.902	8.820	(K ₂ C ₂ O ₄) ₂ .H ₂ C ₂ O ₄ .2H ₂ O
-0.90	2.720	0.0466	" + KH ₃ (C ₂ O ₄) ₂ .2H ₂ O	-5.20	7.616	9.74	"
-0.52	1.672	0.0602	KH ₃ (C ₂ O ₄) ₂ .2H ₂ O	-5.32	7.696	9.84	"
-0.25	0.643	0.210	"	-5.97	8.51	11.01	" + K ₂ C ₂ O ₄ .H ₂ O
-0.58	1.220	0.823	"	-6.55	6.742	10.45	K ₂ C ₂ O ₄ .H ₂ O
-0.78	1.648	1.234	" + KHC ₂ O ₄	-8.10	4.999	10.86	"
-1.50	2.707	2.950	KHC ₂ O ₄	-10.30	3.358	11.76	"
-2.10	3.687	4.363	"	-13.60	1.854	13.08	"
-2.78	4.576	5.50	"	-17.40	1.200	14.55	"
-3.45	5.681	7.05	" + (K ₂ C ₂ O ₄) ₂ .H ₂ C ₂ O ₄ .2H ₂ O	-23.80	0.606	16.89	"

SOLUBILITIES IN THE SYSTEM POTASSIUM OXALATE, OXALIC ACID, WATER AT THE BOILING POINTS.

(Koppel and Cahn, 1908.)

t° of B. pt.	Gms. per 100 Gms. Sat. Sol.		Solid Phase.	t° of B. pt.	Gms. per 100 Gms. Sat. Sol.		Solid Phase.
	C ₂ O ₃ .	K ₂ O.			C ₂ O ₃ .	K ₂ O.	
105.5	39.84	5.25	KH ₃ (C ₂ O ₄) ₂ .2H ₂ O	102.8	19.10	18.25	KHC ₂ O ₄
104.9	36.95	5.83	"	103.25	21.11	21.71	"
104.3	32.75	5.97	"	107.7	25.19	27.91	" + K ₂ C ₂ O ₄ .H ₂ O
103.4	27.64	9.12	"	106.35	22.04	26.45	K ₂ C ₂ O ₄ .H ₂ O
102.9	27.46	11.43	" + KHC ₂ O ₄	106.25	19.17	25.02	"
102.5	23.36	10.50	KHC ₂ O ₄	108.25	12.73	27.60	"
102.4	18.81	12.29	"	111.8	5.35	30.40	"

From the preceding tables the following results for the solubilities of the pure oxalates in water are obtained.

SOLUBILITY OF POTASSIUM OXALATE, K₂C₂O₄.H₂O IN WATER.

t°.	Gms. per 100 Gms. Sat. Sol.			Solid Phase.	t°.	Gms. per 100 Gms. Sat. Sol.			Solid Phase.
	C ₂ O ₃ + K ₂ O = K ₂ C ₂ O ₄ .					C ₂ O ₃ + K ₂ O = K ₂ C ₂ O ₄ .			
-0.78	1.31	1.71	3.02	Ice	30	12.36	16.14	28.50	K ₂ C ₂ O ₄ .H ₂ O
-1.49	2.48	3.20	5.68	"	40	13.20	17.22	30.44	"
-2.50	3.99	5.20	9.195	"	50	14.14	18.46	32.60	"
-3.22	5.15	6.705	11.855	"	60	15.06	19.66	34.72	"
-5.88	8.429	11.01	19.43	" + K ₂ C ₂ O ₄ .H ₂ O	70	15.94	20.81	36.75	"
0	8.83	11.52	20.35	K ₂ C ₂ O ₄ .H ₂ O	80	16.86	22.02	38.875	"
+10	10.48	13.69	24.17	"	90.2	17.73	23.14	40.90	"
20	11.57	15.11	26.675	"	106.2*	19.17	25.02	44.19	"

* b. pt.

100 gms. sat. aq. sol. contain 20.62 gms. K₂C₂O₄ at 0°, $d = 1.161$. (Engel, 1888.)
The results of Hartley, Drugman, Vlieland and Bourdillon (1913) and of Colani (1916), for the solubility of neutral potassium oxalate in water, agree satisfactorily with the above.

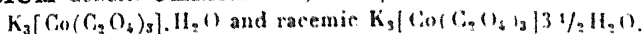
SOLUBILITY OF POTASSIUM BIOXALATE, KHC₂O₄, IN WATER.

(Koppel and Cahn, 1908.)

t°.	Gms. per 100 Gms. Sat. Sol.		Solid Phase.
	C ₂ O ₃ .	K ₂ O.	
60	8.75	6.50	KHC ₂ O ₄
102.4 b. pt.	18.81	12.29	"

The KHC₂O₄ is decomposed to the less soluble tetroxalate at temperatures below 50°.

POTASSIUM Cobalti OXALATES, laevo,



SOLUBILITY OF EACH SEPARATELY IN WATER.

(Jaeger and Thomas, 1918, 1919.)

t°.	Gms. racemic salt per 100 gms. H ₂ O.	t°	Gms. laevo salt, per 100 gms. H ₂ O.
0.....	34.50	20.....	37.40
14.....	36.84	22.....	37.60

By plotting these results the transition temperature is found to be 13.29.

SOLUBILITY OF MIXTURES OF POTASSIUM OXALATE AND OTHER SALTS IN WATER. (Colani, 1916.)

Results at 15°.

Gms. per 100 Gms. Sat. Sol.

10.03	K ₂ C ₂ O ₄ + 19.19	KCl
23.55	" + 1.82	K ₂ SO ₄
20.39	" + 11.60	KNO ₃ (19°)

Results at 50°.

Gms. per 100 Gms. Sat. Sol.

Solid Phase in
Each Case.

15.18	K ₂ C ₂ O ₄ + 20.26	KCl	K ₂ C ₂ O ₄ · H ₂ O + KCl
31.06	" + 1.09	K ₂ SO ₄	" + K ₂ SO ₄
19.63	" + 28.29	KNO ₃	" + KNO ₃

100 gms. aqueous solution, simultaneously saturated with potassium and sodium oxalates, contain 26.15 gms. K₂C₂O₄ + 2.44 gms. Na₂C₂O₄ at 25°.

(Foote and Andrew, 1905).

SOLUBILITY OF MIXTURES OF AMMONIUM OXALATE AND OF POTASSIUM OXALATE IN WATER. (Rivett and O'Conner, 1919.)

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Results at 25°.

Gms.
per 100 gms. sat. sol.

d of sat. sol.	K ₂ C ₂ O ₄	(NH ₄) ₂ C ₂ O ₄	Solid Phase.
1.021	0.00	5.01	(NH ₄) ₂ C ₂ O ₄ · H ₂ O
1.040	2.67	4.72	Solid solution of K ₂ C ₂ O ₄ · H ₂ O in (NH ₄) ₂ C ₂ O ₄ · H ₂ O (I).
1.068	6.51	4.38	
1.108	12.10	4.01	
1.128	15.37	3.68	
1.166	19.39	3.32	
1.204	24.3	2.90	(I) + (II)
1.217	25.9	2.75	
1.216	26.3	1.83	
1.216	26.8	0.85	
1.215	27.2	0.0	

Results at 50°.

Gms.
per 100 gms. sat. sol.

d of sat. sol.	K ₂ C ₂ O ₄	(NH ₄) ₂ C ₂ O ₄	Solid Phase.
1.034	0.0	9.63	(NH ₄) ₂ C ₂ O ₄ · H ₂ O
1.080	7.99	8.40	Solid solution of K ₂ C ₂ O ₄ · H ₂ O in (NH ₄) ₂ C ₂ O ₄ · H ₂ O (I)
1.136	16.20	7.10	
1.154	17.99	6.79	
1.187	22.4	6.10	
1.203	24.4	5.75	
1.254	30.4	4.78	(I) + (II)
1.251	31.0	3.34	
1.252	31.5	2.64	
1.252	33.1	0.0	

No evidence was obtained of the existence of a double salt. The proportion of the two salts in the solid phases varies with the composition of the solution and the evidence is definite that mixed crystals of the two salts are formed.

SOLUBILITY OF POTASSIUM OXALATE IN AQUEOUS SOLUTIONS OF SODIUM OXALATE AND VICE VERSA AT 25°. (Rivett and O'Conner, 1919.)

d of sat. sol.	K ₂ C ₂ O ₄	Na ₂ C ₂ O ₄	Solid Phase.	d of sat. sol.	K ₂ C ₂ O ₄	Na ₂ C ₂ O ₄	Solid Phase.
1.215	27.2	0.0	K ₂ C ₂ O ₄ · H ₂ O	1.178	19.6	3.21	Na ₂ C ₂ O ₄
1.218	26.8	0.77	"	1.135	14.4	3.21	"
1.223	26.3	1.71	"	1.084	8.10	3.40	"
1.226	26.2	2.17	"	1.057	3.99	3.71	"
1.228	26.1	2.50	" + Na ₂ C ₂ O ₄	1.026	0.00	3.71	"

POTASSIUM OXALATE

EQUILIBRIUM IN THE SYSTEM POTASSIUM OXALATE, NICKLE
OXALATE AND WATER AT 30°.
(Vosburg, Israel and Birch, 1936.)

The period of rotation was a week or more and special precautions were necessary to insure that the right solid phase was present. The oxalate content of the samples was determined by permanganate titration and the nickel content either by dimethyl glyoxime or cyanide titration

Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase
$K_2C_2O_4$	NiC_2O_4		$K_2C_2O_4$	NiC_2O_4	
2.26	0.08	SS	23.24	4.55	$K_2Ni(C_2O_4)_2 \cdot xH_2O$
3.77	0.55	"	25.82	4.67	"
5.67	0.57	"	26.83	4.93	"
8.40	1.38	"	26.94	5.13	"
11.08	2.55	"	27.11	5.20	"
12.44	3.53	" + $K_2Ni(C_2O_4)_2 \cdot xH_2O$	30.55	5.85	"
14.22	3.80	$K_2Ni(C_2O_4)_2 \cdot xH_2O$	34.08	7.39	"
16.74	3.28	"	33.03	6.64	" + $K_2C_2O_4 \cdot H_2O$
18.77	3.48	"	33.31	6.81	"
19.95	3.84	"	33.57	6.37	"
20.62	3.87	"	31.07	3.34	$K_2C_2O_4 \cdot H_2O$
22.12	4.02	"	32.51	5.56	"

COO

SS = Solid solutions of potassium and nickel oxalates. Analyses showed that water of crystallization in the double compound was most probably $4H_2O$.

POTASSIUM Telluric Acid OXALATE $K_2[H_6TeO_6 \cdot C_2O_4]$.

SOLUBILITY IN WATER. (Rosenheim and Weinheber, 1910-11.)

	0°	20°	30°	40°	50°
Gms. $K_2[H_6TeO_6 \cdot C_2O_4]$ per 100 gms. H_2O	2.67	5.36	6.82	9.07	12.35

EQUILIBRIUM IN THE SYSTEM POTASSIUM OXALATE, ZINC OXALATE
AND WATER AT 25°.

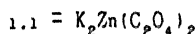
(Metler and Vosburgh, 1935.)

Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase
$K_2C_2O_4$	ZnC_2O_4		$K_2C_2O_4$	ZnC_2O_4	
34.09	11.11	$K_2C_2O_4 \cdot H_2O + 1.1.7$	13.71	4.86	$ZnC_2O_4 \cdot 2H_2O$
29.07	9.70	1.1.7	11.73	3.85	"
23.74	8.36	"	10.45	3.11	"
21.17	7.63	"	9.44	2.59	"
16.71	6.46	"	7.73	1.76	"
15.64	6.20	"	5.72	1.01	"
15.19	6.06	" + $ZnC_2O_4 \cdot 2H_2O$	4.57	0.69	"
14.26	5.80*	"	3.80	0.38	"
10.28	4.42*	"	3.31	0.29	"

* = Metastable, 1.1.7 = $K_2Zn(C_2O_4)_2 \cdot 7H_2O$.

EQUILIBRIUM IN THE SYSTEM POTASSIUM OXALATE
ZINC OXALATE AND WATER AT 35°.
(Metler, 1934.)

Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase
$K_2C_2O_4$	ZnC_2O_4		$K_2C_2O_4$	ZnC_2O_4	
35.96	12.66	$K_2C_2O_4 \cdot H_2O + 1.1$	23.99	12.65	$ZnC_2O_4 \cdot 2H_2O$
35.66	12.78	1.1	21.48	10.69	"
34.56	12.77	"	19.11	8.94	"
32.54	13.02	"	17.72	7.84	"
30.07	13.17	"	13.13	4.82	"
28.33	13.41	"	10.62	3.32	"
26.91	13.68	"	8.14	2.08	"
25.28	13.70	" + $ZnC_2O_4 \cdot 2H_2O$	5.38	0.96	"
			2.14	0.17	"



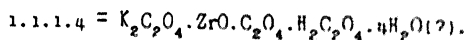
Evidence was also obtained for the metastable existence of the compound $K_2Zn_2(C_2O_4)_3 \cdot 12H_2O$ and the composition of several metastable solutions in contact with this compound are given.

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EQUILIBRIUM IN THE SYSTEM POTASSIUM OXALATE, ZIRCONYL
OXALATE AND WATER AT 35°.
(Boulanger, 1936.)

Tabular results are given for the temperatures 19°, 35° and 52°. Those at 19° yield a very irregular curve. Those at 35° & 52° although giving somewhat better curves probably do not represent equilibrium conditions. The following values taken from the 35° curve indicate roughly the general nature of the system.

Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase
$K_2C_2O_4$	$ZrOC_2O_4$		$K_2C_2O_4$	$ZrOC_2O_4$	
12.0	trace	$K_2C_2O_4 \cdot H_2O$	2.9	1.10	1.1.1.4(?)
8.0	0.06	"	2.8	1.24	?
7.0	0.25	"	2.5	1.20	?
6.5	0.30	1.1.1.4(?)	2.0	0.92	$ZrC_2O_4 \cdot 4H_2O$
5.0	0.28	"	1.5	0.72	"
4.0	0.34	"	1.0	0.60	"
3.5	0.42	"	0.5	0.48	"
3.0	0.80	"			



POTASSIUM CHLORIDE KCl.

SOLUBILITY IN WATER.

(Average curve from the results of Meusser — Z. anorg. Chem. 44, 79, '05; at 31.25°, Köhler — Z. Ver. Zuckerind. 47, 447, '07; Andrae — J. pr. Chem. [2] 29, 456, '84; Gerardin — Ann. chim. phys. [4] 5, 137, '65; de Coppet *Ibid* [5] 30, 411, '83; Etard *Ibid*. [7] 2, 526, '94; Mulder; above 100°, Tilden and Shenstone — Proc. Roy. Soc. (Lond.) 35, 345, '83.)

t°	Gms. KCl per 100 Gms.		t°	Gms. KCl per 100 Gms.		t°	Gms. KCl per 100 Gms.	
	Solution.	Water.		Solution	Water.		Solution.	Water.
-9	19.3	23.9	40	28.6	40.0	147	41.5	70.8
-4.5	20.6	25.9	50	29.9	42.6	180	43.7	77.5
0	21.6	27.6	60	31.3	45.5	Solid Phase Ice		
5	22.7	29.3	70	32.6	48.3	-9	19.3	23.9
10	23.7	31.0	80	33.8	51.1	-8	17.7	21.5
15	24.5	32.4	90	35.1	54.0	-8	16.7	20.0
20	25.4	34.0	100	36.2	56.7	-7	14.9	17.5
25	26.2	35.5	130	39.8	66.0	-6	13.6	15.7
30	27.1	37.0				-5.5	12.5	14.3

Sp. Gr. of solution sat. at 0 = 1.150; at 15° = 1.172.

The following determinations of the solubility of potassium chloride in water, made with exceptional care, are reported by Berkeley (1904).

t°.	d of Sat. Sol.	Gms. KCl per 100 Gms. H ₂ O.	t°.	d of Sat. Sol.	Gms. KCl per 100 Gms. H ₂ O.
0.70	1.1540	28.29	74.80	1.2032	49.58
19.55	1.1738	34.37	89.45	1.2069	53.38
32.80	1.1830	38.32	108 (b. pt.)	1.2118	58.11
59.85	1.1980	45.84			

The following values for the Solubility of Potassium Chloride in Water were read from an average curve drawn through the more recent determinations of: Foote, 1927; Wright, 1927; Scott and Frazier, 1927; Malquori, 1927, 1928a; Flottmann, 1928; Cornec and Krombach, 1932; Lannung, 1934 and Hlering, 1936. The values above 100° are the averages of the determinations of Cornec and Krombach, 1932; Achumow and Wassilijew, 1932, and Benrath, Gjedebø, Schiffers and Wunderlich, 1937.

t°	d. of sat. sol.	Gms. KCl per 100 gms. sat. sol.	t°	d. of sat. sol.	Gms. KCl per 100 gms. sat. sol.
-10.7	(Eutec.)	19.54	120	—	37.5
0	1.154	21.92	130	1.235	38.4
+ 5	—	22.9	140	—	39.3
10	—	23.8	150	1.254	40.2
15	—	24.7	160	—	41.1
20	1.174	25.5	170	1.276	42.0
25	1.1778	26.4	180	—	43.0
30	1.182	27.1	200	1.317	44.7
40	1.189	28.6	225	—	47.0
50	1.194	30.0	250	—	49.3
60	1.199	31.4	275	—	51.6
70	1.203	32.7	300	—	54.0
80	1.205	33.9	350	—	58.6
90	—	35.0	400	—	63.5
100	1.210	36.0	454	—	69.0

FREEZING-POINTS OF AQUEOUS SOLUTIONS OF POTASSIUM CHLORIDE.
(Barnes and Haass, 1930.)

The determinations were made with the greatest possible accuracy. The temperatures of freezing are the averages of the point at which the first crystal of ice appeared and that at which the last crystal disappeared.

t°	Gms. KCl per 100 gms. sat. sol.	Solid Phase	t°	Gms. KCl per 100 gms. sat. sol.	Solid Phase
-2.24	4.95	Ice	-10.31	19.02	Ice
-4.60	9.48	"	-10.72 Eutec.	19.93	" + KCl
-6.88	13.70	"	+25.22	26.41	KCl

THE SOLUBILITY OF POTASSIUM CHLORIDE IN DEUTERIUM WATER
AND IN ORDINARY WATER.
(Shearman and Menzies, 1937.)

The deuterium water had a content of 98.2% D₂O and a density relative to that of ordinary water, of 1.1059. The results are reported in moles of KCl per 1000 gms. of water (= 55.51 moles H₂O) and in 1111.7 gms. of deuterium water (= 55.51 moles D₂O). The same 0.4086 gm. of KCl was employed in both solvents and the amount of deuterium water was 1.39 gm. The actual measurements were graphed and the following values for round temperatures obtained.

Cl

t°	Moles KCl per 55.51 moles:		t°	Moles KCl per 55.51 moles:	
	H ₂ O	D ₂ O		H ₂ O	D ₂ O
0	3.78	3.16	80	6.80	6.52
10	4.20	3.68	100	7.51	7.25
20	4.61	4.16	120	8.21	7.97
25	4.80	4.38	140	8.89	8.67
30	5.00	4.59	160	9.57	9.36
40	5.37	5.01	180	10.24	10.06
60	6.09	5.79			

FREEZING-POINTS OF AQUEOUS SOLUTIONS OF POTASSIUM CHLORIDE.
(Klein and Svanberg, 1920, Rodebush, 1918.)

t.	Gms. KCl per 100 cc. sat. sol.	t.	Gms. KCl per 100 gms. H ₂ O.	t.	Gms. KCl per 100 gms. H ₂ O.
-0.34....	0.7456 (K and S)	-3.07 ..	7.09	-9.84.....	22.69
-0.858...	1.864 "	-4.66...	10.77	-10.34.....	23.80
-1.681...	3.728 "	-7.51...	17.38	-10.66 (eutec.)	24.60

Data for equilibrium in the system potassium chloride + arsenic trioxide + water are given by Schreinmakers and de Haat, 1915.

SOLUBILITY OF POTASSIUM CHLORIDE IN AQUEOUS SOLUTIONS OF HYDROCHLORIC ACID AT 0°

(Jeannel — Compt. rend. 103, 381, '86; Engel — Ann. chim. phys. [6] 13, 377, '88.)

Milligram Mols. per 10 cc.		Grams per 100 cc. Solution.		Sp. Gr. of Solutions.
KCl.	HCl.	KCl.	HCl.	
34.5	0.0	25.73	0.0	1.159
30.41	3.9	22.69	1.42	1.152
27.95	6.6	20.84	2.41	1.150
27.5	7.1	20.51	2.59	1.147
23.75	11.1	17.71	4.05	1.137
16.0	23.0	11.93	8.39	1.111
10.0	34.0	7.46	12.40	1.105
7.5	41.0	5.60	14.95	1.105
2.0	65.5	1.49	23.88	1.121
2.4	148.8 (sat.)	1.52	54.26	1.224

100 cc. saturated HCl solution dissolve 1.9 gms. KCl at 17°. (Ditte, 1881.)

100 gms. sat. aq. HCl solution dissolve 1.9 gms. KCl at 20°. (Stoltzenberg, 1912.)

F.-pt. data for mixtures of KCl and HCl are given by Dernby (1918).

SOLUBILITY OF MIXTURES OF POTASSIUM CHLORIDE AND OF SODIUM CHLORIDE IN AQUEOUS HYDROCHLORIC ACID SOLUTIONS AT 25°.

(Hicks, 1915.)

Gms. per 100 Gms. Sat. Solutions.		
HCl.	NaCl.	KCl.
0	19.95	10.90
8.61	10.65	7.58
17.16	3.56	3.80
20.65	2.03	2.86
32.78	0.18	1.27

SOLUBILITY OF POTASSIUM CHLORIDE IN AQUEOUS SOLUTIONS OF HYDROCHLORIC ACID AT 0° AND AT 25°.

(Armstrong, Eyre, Hussey and Paddinson, 1907; Armstrong and Eyre, 1910-11.)

Solvent, Gms. HCl per 1000 Gms. H ₂ O.	Gms. KCl per 100 Gms. Sat. Sol.	
	At 0°.	At 25°.
0	22.11	26.45
9.11	20.93	25.17
18.22	19.71	24.07
36.45	17.26	21.74
109.35	...	13.47
182.25	...	6.93

SOLUBILITY OF POTASSIUM CHLORIDE IN AQUEOUS SOLUTIONS OF HYDROBROMIC ACID AND OF HYDROCHLORIC ACID AT 25°.

(Heiz, 1911-12.)

In Aq. HBr.				In Aq. HCl.			
Millimols per 10 cc.		Gms. per Liter.		Millimols per 10 cc.		Gms. per Liter.	
HBr.	KCl.	HBr.	KCl.	HCl.	KCl.	HCl.	KCl.
0	42.72	0	318.5	5.66	37.49	20.64	279.6
6.61	37.80	53.5	281.9	10.20	33.79	37.19	252
34:15	19.57	276.4	146	15.91	28.68	57.98	213.9
				20.94	24.74	76.35	146.6
				32.52	17.39	118.6	129.6

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SOLUBILITY OF POTASSIUM CHLORIDE IN AQUEOUS SOLUTIONS
OF HYDROCHLORIC ACID AT 25°.Results of
Malquori, 1928(c)

Results of Ingham, 1928

Gms. per 100 gms. sat. sol.		d $\frac{25}{4}$ of sat. sol.	Gm. Mols. per 1000 cc sat. sol.		d $\frac{25}{4}$ of sat. sol.	Gm. Mols. per 1000 cc sat. sol.	
HCl	KCl		HCl	KCl		HCl	KCl
0.0	26.31		1.1781	0.0	4.199	1.1169	5.672
3.31	20.93		1.1671	0.464	3.748	1.1272	7.144
6.15	15.87		1.1564	0.990	3.288	1.1423	8.433
10.31	10.28		1.1467	1.492	2.887	1.1713	10.68
15.07	6.51		1.1419	1.833	2.604	1.1855	11.74
23.15	2.70		1.1272	2.743	1.951	1.1863	11.81
28.05	1.87		1.1191	3.570	1.449	1.2009	12.96
31.83	1.19		1.1169	4.008	1.227		0.24
40.98	0.15		1.1150	4.665	0.963		

EQUILIBRIUM IN THE SYSTEM POTASSIUM CHLORIDE, POTASSIUM
NITRATE, HYDROCHLORIC ACID, NITRIC ACIDS AND WATER.
(Epstein and Kosterina, 1939.)

Cl

Gm. Mols. per 1000 gm. mols. H ₂ O				Solid Phase
H'	K'	Cl'	NO'	
Results at -20°				
110	14.2	106.7	17.5	KCl + KNO ₃
130	10.4	117.8	22.5	" "
150	7.6	127.3	30.3	" "
170	5.1	134.7	40.4	" "
190	4.8	141.2	53.6	" "
210	6.7	147.0	69.7	" "
220	8.7	149.2	79.5	" "
Results at 0°				
110	20.5	104.0	26.5	" "
130	17.4	104.7	32.7	" "
150	15.1	123.1	42.0	" "
170	14.2	129.7	54.5	" "
190	14.6	134.1	70.5	" "
210	16.7	136.7	90.0	" "
220	20.0	137.5	102.5	" "
Results at 21.5°				
110	39.5	104.5	45.0	" "
130	33.6	111.6	52.0	" "
150	30.8	117.7	63.1	" "
170	30.0	122.5	77.5	" "
190	31.0	126.0	95.0	" "
210	34.7	128.2	116.5	" "
220	38.7	128.7	130.0	" "

SOLUBILITY OF POTASSIUM CHLORIDE IN AQUEOUS SOLUTIONS
OF HYDROGEN PEROXIDE AT 25°.
(Akerlof and Turck, 1935.)

Composition of aq. solvent in:		Gm. Mols. KCl dissolved per 1000 gms. solvent	Composition of aq. solvent in:		Gm. Mols. KCl dissolved per 1000 gms. solvent
Wt. percent	Mol. Fraction		Wt. percent	Mol. Fraction	
H ₂ O ₂	H ₂ O ₂		H ₂ O ₂	H ₂ O ₂	
0.0	0.0	4.826	21.19	0.1270	5.263
5.30	0.0288	4.835	26.24	0.1585	5.362
10.73	0.0599	4.974	31.43	0.1955	5.534
15.72	0.0899	5.093			

SOLUBILITY OF POTASSIUM CHLORIDE IN AQUEOUS SOLUTIONS
OF POTASSIUM CHLORATE AND VICE VERSA.
(Fleck, 1937.)

d. of sat. sol.	Gms. per 100 gms. sat. sol.		Solid Phase	d. of sat. sol.	Gms. per 100 gms. sat. sol.		Solid Phase
	KCl	KClO ₃			KCl	KClO ₃	

Results at 0°

1.153	21.90	0.0	KCl
1.157	21.16	0.71	" + KClO ₃
1.121	16.21	0.82	KClO ₃
1.068	8.47	1.09	"
1.022	0.0	3.05	"

Results at 40°

1.188	28.75	0.0	KCl
1.196	27.74	1.54	"
1.206	26.49	3.15	" + KClO ₃
1.165	20.66	3.88	KClO ₃
1.148	18.43	4.30	"
1.116	13.16	5.44	"
1.106	10.76	6.39	"
1.098	8.71	7.25	"
1.092	7.66	7.64	"
1.084	4.60	9.20	"
1.074	0.0	11.65	"

Results at 20°

1.176	25.70	0.0	KCl
1.183	25.17	0.89	"
1.184	24.60	1.55	" + KClO ₃
(1.177	25.0	1.56	" ")
1.153	20.26	1.75	KClO ₃
1.106	13.47	2.44	"
1.070	7.44	3.74	"
1.051	2.84	5.18	"
1.044	0.0	6.78	"

Results at 50°

1.194	30.18	0.0	KCl
1.207	28.24	3.27	"
1.214	27.45	4.46	" + KClO ₃
(1.211	28.3	4.32	" ")
1.155	18.53	5.76	KClO ₃
1.147	17.55	6.01	"
1.105	8.51	9.66	"
1.088	0.0	14.76	"

Results at 30°

1.182	27.30	0.0	KCl
1.190	26.64	0.87	"
1.198	25.81	2.29	" + KClO ₃
1.140	17.86	3.12	KClO ₃
1.108	13.06	3.82	"
1.097	11.03	4.38	"
1.088	9.45	4.82	"
—	4.67	6.62	"
1.058	0.0	9.24	"

Results at 75°

(1.244	29.30	8.08	KCl + KClO ₃)
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The three determinations in parentheses are by Donald, 1937.

A series of determinations for this system at 20° are reported by DiCapua and Scaletti, 1927, but differ considerably from the above results and are probably incorrect. These authors also give results for the equilibrium in the system $\text{KCl} + \text{NaClO}_3 \rightleftharpoons \text{NaCl} + \text{KClO}_3$ at 20°.

SOLUBILITY OF POTASSIUM CHLORIDE IN AQUEOUS SOLUTIONS
OF POTASSIUM CHROMATE, DICHROMATE AND PERMANGANATE AT 25°.
(Herz and Hiebenthal, 1920.)

Results for aqueous solutions of:

Potassium Chromate				Potassium Dichromate				Potassium Permanganate			
Gm. Mols. per liter		Gm. Mols. per liter		Gm. Mols. per liter		Gm. Mols. per liter		Gm. Mols. per liter		Gm. Mols. per liter	
K_2CrO_4	KCl	K_2CrO_4	KCl	$K_2Cr_2O_7$	KCl	$K_2Cr_2O_7$	KCl	$KMnO_4$	KCl	$KMnO_4$	KCl
0.0	4.19	1.73	3.61	0.04	4.15	0.0	4.19	0.0	4.19	0.0	4.19
0.4	4.01	2.11	3.47	0.08	4.12	0.05	4.02	0.05	4.02	0.05	4.02
0.8	3.87	2.57	3.33	0.16	4.10	0.11	4.04	0.11	4.04	0.11	4.04
1.28	3.74	+ 4.69	2.69	+ 0.28	4.05	+ 0.40	4.00	+ 0.40	4.00	+ 0.40	4.00

SOLUBILITY OF POTASSIUM CHLORIDE IN AQUEOUS SOLUTIONS OF POTASSIUM
IODIDE AT 25° AND VICE VERSA.

(Amadori and Pampanini, 1911.)

Gms. per 100 Gms. H ₂ O.		Gms. per 100 Gms. H ₂ O.	
KCl.	KI.	KCl.	KI.
0	149.26	19.64	68.22
4.06	144.03	23.75	43.89
7.63	137.79	29.56	23.83
11.36	132.60	31.38	14.83
11.74	133.90	33.68	7
15.10	105.91	36.12	0

SOLUBILITY OF POTASSIUM CHLORIDE IN AQUEOUS SOLUTIONS OF
POTASSIUM IODIDE AND VICE VERSA AT SEVERAL TEMPERATURES.

(Harris and Christiansen, 1934.)

Results at 20°

Results at 30°

Results at 40°

Gms. per 100cc sat. solution			Gms. per 100 cc sat. solution			Gms. per 100cc sat. solution		
KCl	KI	Solid Phase	KCl	KI	Solid Phase	KCl	KI	Solid Phase
29.74	0.0	KCl	31.88	0.0	KCl	33.98	0.0	KCl
6.69	90.7	" + KI	7.84	92.9	" + KI	7.86	95.9	" + KI
5.05	92.3	KI	5.53	96.8	KI	5.55	97.9	KI
3.47	95.3	"	4.21	98.0	"	4.39	101.2	"
1.82	97.4	"	2.03	100.4	"	2.04	104.5	"
0.0	100.3	"	0.78	103.2	"	0.0	107.2	"

SOLUBILITY OF MIXTURES OF POTASSIUM CHLORIDE AND POTASSIUM
IODIDE IN WATER.

(Etard — Ann. chim. phys. [7] 3, 275, '94.)

t°	Grams per 100 Gms. Solution.		t°	Grams per 100 Gms. Solution.	
	KCl.	KI.		KCl.	KI.
0	3.7	50.5	100	6.2	61.0
20	4.2	53.0	140	7.3	63.7
40	4.7	55.3	180	8.3	65.5
60	5.2	57.5	220	9.4	66.3
80	5.7	59.4	245	10.0	66.5

SOLUBILITY OF POTASSIUM CHLORIDE IN AQUEOUS SOLUTIONS OF POTASSIUM NITRATE, AND OF POTASSIUM NITRATE IN AQUEOUS SOLUTIONS OF POTASSIUM CHLORIDE, AT SEVERAL TEMPERATURES.

(Touren, 1900; Bodländer, 1891; Nicol, 1891; Soch, 1898.)

KCl in Aq. KNO₃ Solutions at:

14.5° (T.).		25.2° (T.).		20°, etc. (N.).	
Gms. per Liter Solution.		Gms. per Liter Solution.		Gms. per 1000 Gms. H ₂ O.	
KNO ₃ .	KCl	KNO ₃ .	KCl.	KNO ₃ .	KCl.
0	288.3	0	311.8	0	345.2
20.64	284.2	13.76	306.6	56.18	342.15
32.18	282.1	32.18	303.6	168.54	334.39
62.23	276.8	91.26	293.2	at 25° (S)	
82.77	273.5	122.7	287.2	225.8	341.3
115.9	270.7	141.4	284.2	at 80° (S)	
119.1	268.3	182.7	276	1175	402
123.4	267.2				

KNO₃ in Aq. KCl Solutions at:

14.5°.		25.2°.		20°.	
Gms. per Liter Solution.		Gms. per Liter Solution.		Gms. per 1000 Gms. H ₂ O.	
KCl.	KNO ₃ .	KCl.	KNO ₃ .	KCl.	KNO ₃ .
0	225.4	0	325.5	0	311.1
13.58	219.8	19.39	312.3	82.9	256.8
31.63	208.2	49.22	288.7	165.8	221.7
65.64	185.2	100.7	254	248.7	202
132.6	159.5	155.2	224.4	310.8	501.6
164.4	153.3	207.3	203.9		
196.5	144	226.8	196.9		
236.9	137.1				

In the case of the results by Touren, constant temperature and agitation were employed.

KNO ₃ in Aq. KCl at 20.5° (B.).			KCl in Aq. KNO ₃ at 17.5° (B.).		
Gms. per 100 cc. Solution.		Sp. Gr. of Solutions.	Gms. per 100 cc. Solution.		Sp. Gr. of Solutions.
KCl.	KNO ₃ .		KNO ₃ .	KCl.	
0	27.68	1.1625	0	29.39	1.1730
4.72	24.39	1.1700	6.58	27.50	1.1980
7.74	22.44	1.1765	8.88	27.34	1.2100
12.23	20.23	1.1895	12.48	26.53	1.2250
15.15	18.96	1.1983	14.83	25.98	1.2360
19.61	17.67	1.2150	15.22	25.96	1.2390
22.17	17.11	1.2265	15.49	25.95	1.2388
24.96	16.79	1.2400	15.33	26.24	1.2410

In the case of the above results by Bodländer, a saturated aqueous solution of potassium chloride was prepared and weighed amounts of potassium nitrate were added to measured volumes of it. The mixtures were warmed and then allowed to cool to the indicated temperature and frequently shaken during 24 hours.

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SOLUBILITY OF POTASSIUM CHLORIDE IN AQUEOUS SOLUTIONS
OF POTASSIUM IODATE AND VICE VERSA.

(Hill and Ricci, 1931.)

d. of sat. sol.	Gms. per 100 gms. KIO ₃	sat. sol. KCl	Solid Phase	d. of sat. sol.	Gms. per 100 gms. KIO ₃	sat. sol. KCl	Solid Phase
Results at 5°				Results at 25° (Con.)			
1.155	0.0	22.84	KCl	1.073	4.29	5.93	KIO ₃
1.170	1.44	22.64	" + KIO ₃	1.066	5.83	2.78	"
1.147	1.50	19.56	KIO ₃	1.071	8.45	0.0	"
1.084	1.79	10.13	"				
1.044	2.91	3.03	"	Results at 50°			
1.043	5.16	0.0	"	—	0.0	30.03	KCl
				—	1.77	29.40	"
				—	3.07	29.08	" + KIO ₃
1.179	0.0	26.36	KCl	—	3.74	23.17	KIO ₃
1.197	2.10	25.82	" + KIO ₃	—	4.71	15.64	"
1.153	2.40	19.64	KIO ₃	—	7.43	6.83	"
1.109	3.01	12.37	"	—	13.31	0.0	—

SOLUBILITY OF POTASSIUM CHLORIDE IN AQUEOUS SOLUTIONS OF POTASSIUM
NITRATE AT 0° AND AT 25°.

(Armstrong and Eyre, 1910-11.)

Cl

Solvent, Gms. KNO ₃ per 1000 Gms. H ₂ O.	Gms. KCl Dissolved per 100 Gms. Sat. Solution at:	
	0°.	25°.
0	22.10	26.73
25.27	21.71	26.26
50.55	21.25	25.61
101.11	20.70	24.58
151.66	...	23.57

SOLUBILITY OF POTASSIUM CHLORIDE IN AQUEOUS SOLUTIONS OF POTASSIUM
NITRATE AND VICE VERSA.

(Leather and Mukerji, 1913.)

Results at 30°.			Results at 40°.			Results at 91°.			Solid Phase in Each Case.
Sp. Gr. Sat. Sol.	Gms. per 100 Gms. H ₂ O.		Sp. Gr. Sat. Sol.	Gms. per 100 Gms. H ₂ O.		Sp. Gr. Sat. Sol.	Gms. per 100 Gms. H ₂ O.		
	KCl.	KNO ₃ .		KCl.	KNO ₃ .		KCl.	KNO ₃ .	
1.186	37.58	0	1.194	40.60	0	1.222	53.58	0	KCl
1.219	36.72	8.05	1.252	39.11	16.86	1.344	47.85	52.75	"
1.251	36.19	10.36	1.305	37.08	35.45	1.486	43.30	114.6	"
1.281	35.42	26.83	1.319	37.40	39.71	1.552	30.00	162.0	" + KNO ₃
1.258	28.71	29.19	1.312	32.22	41.52	1.544	33.25	165.6	KNO ₃
1.241	19.35	32.34	1.297	22.63	46.31	1.545	15.56	181.1	"
1.225	9.44	38.10	1.279	11.58	52.66	1.552	0	202.8	"

Results are also given for 20°.

SOLUBILITY OF POTASSIUM CHLORIDE IN AQUEOUS SOLUTIONS OF POTASSIUM NITRATE
AND VICE VERSA AT 30°.

(Barbaud, 1923.)

Gms. per 100 gms. sat. sol.	Solid Phase.	Gms. per 100 gms. sat. sol.	Solid Phase.
KCl.		KCl.	
27.2	0.0	21.3	16.8
23.43	11.63	20.25	17.25
22.78	13.42	10.48	22.0
22.18	16.39	5.48	26.36
21.9	16.65	0.0	31.4
	" + KNO ₃		"

Data for equilibrium in the system potassium chloride + potassium oxalate + water at 20° are given by Trifunov, 1924-1925.

SOLUBILITY OF POTASSIUM CHLORIDE IN AQUEOUS SOLUTIONS OF
POTASSIUM NITRATE AND VICE VERSA AT 18.5°.

(Holluta and Mautner, 1977.)

To standard solutions of one of the salts an excess of the other salt was added and the mixtures heated to 60° and then cooled and shaken at 18.5° until equilibrium was attained. A given volume of the saturated solution was evaporated to dryness and from the weight of the residue, the concentration of the original aq. solvent and of the original solvent and the final saturated solution, the weight of each salt present in 100cc of the saturated solution was calculated. The results thus obtained agreed satisfactorily with calculations based upon chloride determinations.

Gm. Mols. KNO_3 per liter aq. solvent	d. of sat. sol.	Gms. per 1000 cc sat. solution		Gm. Mols. KCl per liter aq. solvent	d. of sat. sol.	Gms. per 1000 cc sat. solution	
		KNO_3	KCl			KCl	KNO_3
0.0	1.1738	0.0	298.50	0.0	1.1560	0.0	265.92
0.2	1.1820	17.74	294.84	0.2	1.1573	13.36	254.64
0.4	1.1899	35.46	292.32	0.4	1.1598	26.80	245.84
0.6	1.1985	53.28	288.86	0.6	1.1621	40.38	235.66
1.0	1.2147	88.86	283.16	1.0	1.1682	67.76	218.96
1.5	1.2348	133.66	274.62	2.0261	1.1887	139.16	184.74
1.6671	1.2415	148.84	271.24	3.0025	1.2141	207.94	163.74
				3.8975	1.2415	271.24	148.82

SOLUBILITY OF POTASSIUM CHLORIDE IN AQUEOUS SOLUTIONS
OF POTASSIUM NITRATE AND VICE VERSA AT 25°.

(Nikalajew, 1929.)

Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase
KCl	KNO_3		KCl	KNO_3	
26.5	0.0	KCl	15.64	17.20	KNO_3
25.05	4.30	"	10.65	19.82	"
23.75	7.92	"	6.74	22.30	"
22.95	11.41	"	4.50	24.02	"
21.94	14.72	" + KNO_3	0.0	27.86	"

Results are also given for the effect upon the above equilibrium of the presence of varying concentrations of HCl and of KOH.

The following values for the simultaneous solubility of KCl + KNO_3 in water at other temperatures than 25° are also given by Nikalajew, 1929.

t°	Gms. per 100 gms. sat. sol.		Solid Phase	t°	Gms. per 100 gms. sat. sol.		Solid Phase
	KCl	KNO_3			KCl	KNO_3	
0.2	20.44	6.38	KCl + KNO_3	60	18.56	34.12	KCl + KNO_3
17.0	22.23	11.00	"	80	15.47	46.29	" "
40.0	21.28	21.98	"	100	14.96	53.88	" "

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SOLUBILITY OF POTASSIUM CHLORIDE IN AQUEOUS SOLUTIONS OF POTASSIUM NITRATE AND VICE VERSA AT SEVERAL TEMPERATURES.
(Hering, 1926.)

d. of sat. sol.	Gas. per 100 gas. H ₂ O		Solid Phase	d. of sat. sol.	Gas. per 100 gas. H ₂ O		Solid Phase
KCl	KNO ₃			KCl	KNO ₃		
Results at 0°				Results at 75°			
—	27.9	0.0	KCl	1.201	49.6	0.0	KCl
—	27.7	8.72	" + KNO ₃	1.252	47.5	16.8	"
—	0.0	13.3	KNO ₃	1.316	45.3	40.6	"
Results at 25°				1.388	42.5	72.7	"
1.179	35.9	0.0	KCl	1.457	39.4	111.0	" + KNO ₃
1.238	34.8	16.3	"	1.454	35.0	122.0	KNO ₃
1.261	34.5	23.0	" + KNO ₃	1.457	10.2	139.0	"
1.256	32.8	23.3	KNO ₃	1.462	0.0	153.0	"
1.213	15.9	28.0	"	Results at 100°			
1.197	8.0	32.2	"	1.211	55.5	0.0	KCl
1.189	0.0	38.3	"	1.365	49.3	65.0	"
Results at 50°				1.479	43.5	132.0	"
1.194	42.4	0.0	KCl	1.568	42.1	204.0	" + KNO ₃
1.350	38.2	54.1	" + KNO ₃	1.565	31.0	209.0	KNO ₃
1.333	23.7	61.3	KNO ₃	1.565	15.2	224.0	"
1.329	11.9	71.5	"	1.569	0.0	244.0	"
1.332	0.0	85.7	"				

Additional results for this system at 0°, 20°, 40°, 60°, 80°, 100° and 320° in terms of the number of gm. mols. H₂O required to dissolve 100 gm. mols. of the two salts of determined molecular ratio, are given by Jänecke, 1928.

SOLUBILITY OF POTASSIUM CHLORIDE, POTASSIUM NITRATE AND POTASSIUM SULFATE IN WATER AT SEVERAL TEMPERATURES.
(Hering, 1926.)

t°	d. of sat. sol.	Gas. per 100 gas.		H ₂ O		Solid Phase
		KCl	KNO ₃	K ₂ SO ₄		
0	—	27.4	8.8	1.15	KCl + KNO ₃ + K ₂ SO ₄	
25	1.212	34.9	7.42	1.45	KCl + K ₂ SO ₄	
"	1.236	34.5	14.4	1.41	"	
"	1.266	34.2	23.1	1.40	"	+ KNO ₃
50	1.353	37.6	53.6	1.57	"	"
75	1.258	46.6	16.7	2.08	"	"
"	1.322	44.4	40.8	1.93	"	"
"	1.393	41.8	72.9	1.80	"	"
"	1.461	39.1	110.3	1.77	"	+ KNO ₃
100	1.573	39.8	204.0	1.86	"	"

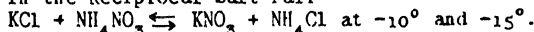
The following values for this system are given by Kritschensky and Goldmann, 1933.

25	—	35.23	23.84	0.70	KCl + KNO ₃
"	—	35.82	12.48	1.45	" + K ₂ SO ₄
"	—	31.22	21.66	1.38	" + KNO ₃
"	—	12.57	29.77	2.66	KNO ₃ + K ₂ SO ₄

EQUILIBRIUM IN SYSTEMS COMPOSED OF POTASSIUM AND SODIUM CHLORIDES
NITRATES AND SULFATES.

Complete experimental data, including densities, in the form of tabular results and diagrams for these complex systems at temperatures between 0° and 90° are given by Cornec and Krombach, 1929, and Cornec, Krombach and Spack, 1930. These authors have made use, when necessary, of the results for the ternary and quaternary systems previously reported from their own laboratory and by other workers, including, Chretien, 1929, Cornec and Hering, 1925-7, Cornec and Krombach, 1929, Meyerhoffer and Saunders, 1899, d'Ans, 1915 and Blasdale, 1918.

Equilibrium in the Reciprocal Salt Pair



(Kritschewsky and Goldmann, 1934.)

These results supplement the previous determinations of Jänecke, 1928, at $0-80^{\circ}$ and Aronawa and Lunskaia, 1933, at 100° .

Results at -15°				Results at -10°				Solid Phase
Gm. Mols. per 1000 gms. H_2O				Gm. Mols. per 1000 gms. H_2O				
KCl	NH_4Cl	KNO_3	NH_4NO_3	KCl	NH_4Cl	KNO_3	NH_4NO_3	
1.64	4.11	—	—	1.60	4.15	—	—	KCl + NH_4Cl
—	3.79	—	7.67	—	3.99	—	9.16	NH_4Cl + NH_4NO_3
—	—	0.892	10.33	—	—	1.04	11.96	KNO_3 + " NH_4NO_3
—	—	—	—	2.45	1.91	—	—	KCl
—	—	—	—	0.661	4.63	—	—	NH_4Cl
—	—	—	—	1.38	4.48	0.502	—	" + KCl
0.976	4.35	0.774	—	1.14	4.59	0.921	—	" + " + KNO_3
—	3.90	0.890	8.28	—	3.90	0.900	9.49	NH_4Cl + NH_4NO_3 " KNO_3 + "

SOLUBILITY DATA FOR THE RECIPROCAL SALT PAIRS $\text{KCl} + \text{NaNO}_3 \rightleftharpoons \text{NaCl} + \text{KNO}_3$
AT 5° , 25° , 50° AND 100° .

(Reinders, 1914, 1915; see also Uyeda, 1909-10.)

Results at 25°.				Results at 50°.				Solid Phase in Each Case.
Gms. per 100 Gms. H ₂ O.				Gms. per 100 Gms. H ₂ O.				
NaCl.	KCl.	NaNO ₃ .	KNO ₃ .	NaCl.	KCl.	NaNO ₃ .	KNO ₃ .	
36.04	...	...	...	36.72	...	...	...	NaCl
32.28	10	...	...	...	...	...	...	"
30.27	16.45	...	...	28.35	23.09	...	...	NaCl+KCl
12	26.78	...	...	...	42.80	...	...	KCl
...	35.54	...	10	...	41.39	...	24.05	"
...	34.92	...	22.79	...	38.75	...	52.54	KCl+KNO ₃
...	10	...	31.48	...	...	...	85.10	KNO ₃
...	...	10	37.49	...	...	...	...	"
...	...	60	41.87	...	...	...	...	"
...	...	100.9	46.15	...	...	134.9	90.2	KNO ₃ +NaNO ₃
...	...	96.06	20	...	...	114.1	...	NaNO ₃
10	...	77.46	...	...	...	...	...	"
23.62	...	58.01	...	20.5	...	84.8	...	NaNO ₃ +NaCl
33.90	...	10	...	28.4	...	43.9	...	NaCl
24.82	22.2	15.4	...	34	13.4	...	24.3	NaCl+KCl
21.36	20	...	32.9	12.7	25.4	...	58.6	KCl+KNO ₃
24.5	...	61.3	17.2	...	...	...	...	KNO ₃ +NaNO ₃
7	...	82.1	43.15	19.2	...	104.1	27.2	NaNO ₃ +NaCl
23.8	...	64	41.2	12.2	...	110.7	82.2	NaCl+NaNO ₃ +KNO ₃
4.5	...	...	40.3	59.9	...	6.1	70.9	NaCl+KCl+KNO ₃

Results at 5°.				Results at 100°.				Solid Phase in Each Case.
Gms. per 100 Gms. H ₂ O.				Gms. per 100 Gms. H ₂ O.				
NaCl.	KCl.	NaNO ₃ .	KNO ₃ .	NaCl.	KCl.	NaNO ₃ .	KNO ₃ .	
31.50	10.4	...	...	27.3	36.2	...	...	NaCl+KCl
...	29.84	...	10.14	...	41.6	...	199	KCl+KNO ₃
...	...	82.10	18.1	...	...	233.6	218	KNO ₃ +NaNO ₃
27.6	...	41.7	...	19.2	...	158	...	NaNO ₃ +NaCl

SOLUBILITY OF POTASSIUM CHLORIDE IN AQUEOUS SOLUTIONS OF
POTASSIUM HYDROXIDE AT VARIOUS TEMPERATURES. (von Antropoff, 1924.)

Gms. KOH per 100 gms. sat. sol.	Gms. KCl per 100 gms. sat. solution at					
	-21°3.	-11°1.	0°.	10°.	20°.	30°.
5		15.4(1.180)	17.6(1.185)	19.2(1.184)	20.8(1.180)	22.2(1.182)
10		11.7(1.189)	13.5(1.194)	15.0(1.203)	16.4(1.201)	17.9(1.204)
15	7.9(1.204)	8.8(1.206)	9.9(1.219)	11.3(1.227)	12.3(1.226)	13.6(1.230)
20	5.6(1.239)	6.3(1.238)	7.2(1.249)	8.0(1.256)	8.8(1.259)	10.2(1.258)
25	3.6(1.280)	4.2(1.278)	4.9(1.283)	5.4(1.285)	6.2(1.283)	7.4(1.289)
30	2.2(1.326)	2.6(1.323)	3.0(1.322)	3.6(1.324)	4.2(1.318)	5.0(1.323)
35	1.2(1.376)	1.5(1.379)	1.8(1.370)	2.2(1.366)	2.6(1.362)	3.2(1.364)
40	0.7(1.430)	0.9(1.425)	1.0(1.419)	1.3(1.415)	1.5(1.411)	1.8(1.409)
45	0.4(1.486)	0.5(1.478)	0.6(1.471)	0.7(1.469)	0.9(1.465)	1.1(1.460)
50	—	—	—	0.5(1.525)	0.6(1.521)	0.8(1.515)
55	—	—	—	—	—	0.5(1.571)

Gms. KOH per 100 gms. sat. sol.	Gms. KCl per 100 gms. sat. solution at					
	50°.	50°.	90°.	130°.	150°.	180°.
5	24.7 (1.186)	27.3 (1.196)	29.7 (1.214)	33.0	36.0	38.3
10	20.2 (1.208)	22.7 (1.220)	24.8 (1.231)	27.9	30.8	33.1
15	16.0 (1.236)	18.4 (1.243)	20.0 (1.250)	22.9	25.8	28.1
20	12.3 (1.263)	14.4 (1.270)	15.9 (1.272)	18.0	21.2	23.5
25	9.1 (1.293)	10.8 (1.299)	12.1 (1.298)	14.5	17.0	19.1
30	6.3 (1.324)	7.7 (1.330)	9.1 (1.330)	11.3	13.8	15.3
35	4.1 (1.358)	5.3 (1.364)	6.6 (1.367)	8.8	10.5	12.1
40	2.5 (1.404)	3.7 (1.404)	4.5 (1.408)	6.7	8.0	9.3
45	1.6 (1.458)	2.5 (1.451)	3.1 (1.451)	5.0	6.0	7.1
50	1.1 (1.511)	1.7 (1.505)	2.2 (1.509)	3.3	4.4	5.5
55	0.9 (1.568)	1.1 (1.566)	1.8 (1.556)	2.5	3.4	4.7
60	—	—	1.4 (1.618)	2.0	2.7	4.0
65	—	—	—	1.7	2.5	3.9
70	—	—	—	—	2.7	—

The figures in parentheses are the densities of the saturated solutions.

SIMULTANEOUS SOLUBILITY OF POTASSIUM CHLORIDE AND POTASSIUM HYDROXIDE
AT THE EUTECTIC TEMPERATURES. (von Antropoff, 1924.)

Eutec. temp.	Gms. per 100 gms. sat. sol.		Solid Phase.	Eutec. temp.	Gms. per 100 gms. sat. sol.		Solid Phase.
	KOH.	KCl.			KOH.	KCl.	
-21.30	11.23	9.69	KCl + ice	50	48.93	0.44	KOH · 2H ₂ O + KCl
-17.35	10.62	10.24	"	10	50.69	0.45	" "
-11.0	—	19.74	"	20	51.83	0.55	" "
-67.2	30.73	0.23	KOH · 2H ₂ O + ice	30	55.28	0.47	" "
-65.2	30.83	—	" "	50	58.09	0.67	KOH · H ₂ O + "
-65.6	29.62	—	" "	70	59.63	0.91	" "
-64.3	30.59	0.43	" " + KCl	90	61.75	1.25	" "
-21.3	46.6	0.38	KOH · 2H ₂ O + KCl	120	65.31	1.70	" "
-11.1	47.45	0.38	" "	150	73.57	2.87	KOH + "

SOLUBILITY OF POTASSIUM CHLORIDE IN AQUEOUS SOLUTIONS OF
POTASSIUM HYDROXIDE AT 20°. (Brønsted, 1920 a.)

Gm. mols. per liter.		Gm. mols. per liter.		Gm. mols. per liter.	
KOH.	KCl.	KOH.	KCl.	KOH.	KCl.
4.71	1.605	11.10	0.253	14.02	0.136
7.90	0.712	12.19	0.191	14.85	0.121
9.41	0.405	12.92	0.168	15.02	0.118
10.95	0.273	13.84	0.138		

SOLUBILITY OF POTASSIUM CHLORIDE IN AQUEOUS SOLUTIONS
OF POTASSIUM HYDROXIDE AT 25°.

(Akerlöf and Short, 1937.)

Gm. Mols. per 1000 gms. H ₂ O		Gm. Mols. per 1000 gms. H ₂ O		Gm. Mols. per 1000 gms. H ₂ O		Gm. Mols. per 1000 gms. H ₂ O	
KOH	KCl	KOH	KCl	KOH	KCl	KOH	KCl
1.023	4.079	4.102	2.265	8.37	0.894	15.53	0.281
1.053	4.056	5.187	1.847	9.43	0.750	16.59	0.247
2.033	3.397	5.273	1.839	10.54	0.638	18.42	0.210
2.126	3.365	6.108	1.444	11.28	0.529	19.32	0.198
2.897	2.889	6.203	1.576	12.53	0.433	20.64	0.183
3.150	2.778	7.210	1.246	13.42	0.370	20.55	0.184
3.998	2.473	7.211	1.175	14.44	0.311		

The solid phase is KCl in all cases.

SOLUBILITY OF POTASSIUM CHLORIDE IN AQUEOUS SOLUTIONS
OF POTASSIUM HYDROXIDE AT THE BOILING POINTS.

(von Antropoff, 1924.)

B. pt.	d of sat. sol.	Gms. per 100 gms. sat. sol.		B. pt.	d of sat. sol.	Gms. per 100 gms. sat. sol.	
		KOH.	KCl.			KOH.	KCl.
108.5	—	0.0	36.5	120.7	1.351	30.0	11.9
109.2	1.227	5.0	31.9	125.7	1.382	35.0	9.6
110	1.245	10.0	27.4	131.5	1.415	40.0	7.7
111.5	1.266	15.0	22.9	139.3	1.448	45.0	6.4
113.5	1.292	20.0	18.7	151.5	1.8	50.0	5.4
116.5	1.320	25.0	14.9	166.3	—	55.0	4.7

SOLUBILITY OF POTASSIUM CHLORIDE IN AQUEOUS SOLUTIONS
OF MONO POTASSIUM PHOSPHATE AND VICE VERSA AT 0°.

(Askenasy and Nessler, 1930.)

The results are expressed in the Jänecke method which is in terms of the number of gm. mols. of H₂O required to dissolve 100 gm. mols. of salt or salt mixture of determined molecular composition.

d. of sat. sol.	Composition of Dissolved Salts in Gm. Mols.		Gm. Mols. H ₂ O to dissolve 100 gm. mols. salt mixture	Solid Phase
	KCl	KH ₂ PO ₄		
1.1420	100.0	0.0	1440	KCl
1.1690	95.8	4.2	1420	"
1.1750	92.1	7.9	1415	" + KH ₂ PO ₄
1.1427	73.0	27.0	1840	KH ₂ PO ₄
1.1199	62.7	37.3	2210	"
1.1183	44.9	55.1	2860	"
1.1179	31.7	68.3	3320	"
1.1158	18.1	81.9	3540	"
1.1151	0.0	100.0	4125	"

The author also gives results for the quarternary system (K, NH₄) (Cl, H₂PO₄) + H₂O at 0°.

SOLUBILITY OF POTASSIUM CHLORIDE IN AQUEOUS SOLUTIONS
OF POTASSIUM SULFATE AND VICE VERSA..

(Hering, 1926.)

d. of sat. sol.	Gms. per 100 gms. H ₂ O	Solid Phase	d. of sat. sol.	Gms. per 100 gms. H ₂ O	Solid Phase
K_2SO_4	KCl		K_2SO_4	KCl	

Results at 0°

—	0.0	27.9	KCl
—	1.08	27.7	" + K_2SO_4
—	7.38	0.0	K_2SO_4

Results at 50° (con.)

1.104	16.5	0.0	K_2SO_4
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Results at 75°

1.179	0.0	35.9	KCl
1.185	1.45	35.7	" + K_2SO_4
1.153	2.13	27.1	K_2SO_4
1.120	3.40	18.2	"
1.092	6.07	9.2	"
1.086	12.1	0.0	"
1.203	0.0	49.6	KCl
1.211	2.14	48.8	" + K_2SO_4
1.171	3.46	36.3	K_2SO_4
1.135	5.82	24.3	"
1.110	10.8	12.3	"
1.116	20.6	0.0	"

Results at 100°

1.194	0.0	43.0	KCl
1.200	1.79	42.4	" + K_2SO_4
1.211	0.0	55.5	KCl
1.216	2.55	55.0	" + K_2SO_4
1.119	24.0	0.0	K_2SO_4

SOLUBILITY OF POTASSIUM CHLORIDE IN AQUEOUS SOLUTIONS
OF POTASSIUM SULFATE AT 100° AND VICE VERSA.

(Campbell, Downes and Samis, 1924.)

Gms. per 100 gms. sat. sol.	Solid Phase	Gms. per 100 gms. sat. sol.	Solid Phase
K_2SO_4	KCl	K_2SO_4	KCl
0.0	35.60	5.54	18.63
1.56	34.64	11.00	8.58
1.63	35.96	18.76	0.0
2.46	28.58		

SOLUBILITY OF MIXTURES OF POTASSIUM CHLORIDE AND POTASSIUM
SULFATE IN WATER.

t°.	Gms. per 100 Gms. H ₂ O.	Observer.	t°.	Gms. per 100 Gms. H ₂ O.	Observer.
	KCl + K_2SO_4			KCl + K_2SO_4	
10	30.9 1.32	(Precht & Wittgen.)	40	38.7 1.68	(P. and W.)
15.8	28 2.3	(Kopp.)	50	41.3 1.82	"
20	33.4 1.43	(P. and W.)	60	43.8 1.94	"
25	34.76 2.93	(Van't Hoff & Meyerhoffer.)	80	49.2 2.21	"
30	36.1 1.57	(P. and W.)	100	54.5 2.53	"

100 gms. aq. solution, sat. with both salts, contain 26.2 gms. KCl + 1.09 gms. K_2SO_4 at 30°.

(Schreinemakers and de Baat, 1914.)

EQUILIBRIUM IN THE SYSTEM POTASSIUM CHLORIDE, POTASSIUM
SULFATE AND POTASSIUM CARBONATE IN WATER.

(Teeple, 1929.)

Gms. per 100 gms. H ₂ O			Solid Phase	Gms. per 100 gms. H ₂ O			Solid Phase
KCl	K ₂ SO ₄	K ₂ CO ₃		KCl	K ₂ SO ₄	K ₂ CO ₃	
Results at 35°				Results at 50° (con.)			
39.0	—	—	KCl	3.6	—	121.3	K ₂ CO ₃ · 1½H ₂ O + KCl
—	14.1	—	K ₂ SO ₄	—	trace	121.2	" + K ₂ SO ₄
—	—	115.1	K ₂ CO ₃ · 1½H ₂ O	3.6	"	121.2	" + " + KCl
38.4	1.7	—	KCl + K ₂ SO ₄	Results at 75°			
3.1	—	114.1	" + K ₂ CO ₃ · 1½H ₂ O	49.7	—	—	KCl
—	trace	112.5	K ₂ CO ₃ · 1½H ₂ O + K ₂ SO ₄	—	20.6	—	K ₂ SO ₄
2.9	"	112.7	" + KCl	—	—	136.4	K ₂ CO ₃ · 1½H ₂ O
Results at 50°				48.5	1.9	—	KCl + K ₂ SO ₄
43.1	—	—	KCl	5.2	—	134.9	K ₂ CO ₃ · 1½H ₂ O + KCl
—	17.1	—	K ₂ SO ₄	—	trace	135.8	" + K ₂ SO ₄
—	—	121.2	K ₂ CO ₃ · 1½H ₂ O	5.2	"	133.5	" + " + KCl
42.2	1.8	—	K ₂ SO ₄ + KCl				

Cl

Data for the following four or more component Systems containing KCl, in Water, are given by Teeple, 1929.

KCl + NaCl + Na₂SO₄ + K₂SO₄ at 35°, 50° and 75°.
 KCl + NaCl + Na₂CO₃ + K₂CO₃ at 35°, 50° and 75°.
 KCl + NaCl + Na₂SO₄ + K₂SO₄ + Na₂CO₃ + K₂CO₃ at 20°, 35°, 50°, 75° and 100°
 KCl + NaCl + Na₂B₄O₇ + K₂B₄O₇ at 35°.
 KCl + NaCl + Na₂B₁₀O₁₆ + K₂B₁₀O₁₆ at 35°.

SOLUBILITY DATA FOR THE RECIPROCAL SALT PAIRS KCl + Na₂SO₄ ⇌ K₂SO₄ + NaCl.
(Meyerhoffer and Saunders, 1899.)

t°.	d _s of Sat. Sol.	Mols. per 1000 Mols. H ₂ O.				Solid Phase.
		SO ₄ .	K ₂ .	Na ₂ .	Cl ₂ .	
4.4*	...	5.42	14.39	51.83	60.8	K ₂ Na(SO ₄) ₂ + KCl + NaCl
0.2	...	3.35	12.78	50.93	60.36	Na ₂ SO ₄ · 10H ₂ O + KCl + NaCl
0.4	...	3.59	16.38	40.75	53.54	Na ₂ SO ₄ · 10H ₂ O + KCl + K ₂ Na(SO ₄) ₂
16	...	4.72	17.58	50.56	63.42	K ₂ Na(SO ₄) ₂ + KCl + NaCl
24.8	1.2484	4.37	20.02	48.36	64.01	"
16.3*	...	16.29	9.16	61.06	53.93	K ₂ Na(SO ₄) ₂ + NaCl + Na ₂ SO ₄ · 10H ₂ O + Na ₂ SO ₄
24.5	1.2625	14.45	9.90	58.46	53.91	K ₂ Na(SO ₄) ₂ + NaCl + Na ₂ SO ₄
0.3	...	2.75	25.77	17.93	40.95	K ₂ Na(SO ₄) ₂ + KCl + K ₂ SO ₄
25	1.2034	2.94	36.20	14.80	48.06	"
17.9*	1.2470	13.84	0	62.54	48.70	Na ₂ SO ₄ · 10H ₂ O + Na ₂ SO ₄ + NaCl
30.1*	1.289	50.41	10.08	40.33	0	K ₂ Na(SO ₄) ₂ + Na ₂ SO ₄ · 10H ₂ O + Na ₂ SO ₄
					tr. pt.	

Curves are given in the original paper and a complete discussion of the older work.

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 SOLUBILITY OF MIXTURES OF SODIUM SULFATE, POTASSIUM CHLORIDE,
 POTASSIUM SULFATE, ETC., IN WATER.
 (Meyerhoffer and Saunders, 1899.)

t°.	Sp. Gr. of Solutions.	Mols. per 1000 Mols. H ₂ O.				Solid Phase.
		SO ₄	K ₂	Na ₂	Cl ₂	
*4.4	...	5.42	14.30	51.83	60.8	K ₂ Na(SO ₄) ₂ +Na ₂ SO ₄ .10H ₂ O+KCl+NaCl
0.2	...	3.35	12.78	50.93	60.36	Na ₂ SO ₄ .10H ₂ O+KCl+NaCl
-0.4	...	3.59	16.38	40.75	53.54	Na ₂ SO ₄ .10H ₂ O+KCl+K ₂ Na(SO ₄) ₂
16.3	...	4.72	17.58	50.56	63.42	K ₂ Na(SO ₄) ₂ +KCl+NaCl
24.8	1.2484	4.37	20.00	48.36	64.01	K ₂ Na(SO ₄) ₂ +KCl+NaCl
*16.3	...	16.29	9.16	61.06	53.93	K ₂ Na(SO ₄) ₂ +NaCl+Na ₂ SO ₄ .10H ₂ O+Na ₂ SO ₄
24.5	1.2625	14.45	9.90	58.46	53.91	K ₂ Na(SO ₄) ₂ +NaCl+Na ₂ SO ₄
0.3	...	2.75	25.77	17.93	40.95	K ₂ Na(SO ₄) ₂ +KCl+K ₂ SO ₄
25.0	1.2034	2.94	36.20	14.80	48.06	K ₂ Na(SO ₄) ₂ +KCl+K ₂ SO ₄
*17.9	1.2474	13.84	0.0	62.57	48.70	Na ₂ SO ₄ .10H ₂ O+Na ₂ SO ₄ +NaCl
*30.1	1.2890	50.41	10.08	40.33	0.0	K ₂ Na(SO ₄) ₂ +Na ₂ SO ₄ .10H ₂ O+Na ₂ SO ₄
-21.4	...	...	...	46.61	46.36	NaCl.2H ₂ O+Na ₂ SO ₄ .10H ₂ O
-23.7	...	...	10.51	39.58	50.09	NaCl.2H ₂ O+KCl
-10.9	...	1.45	30.68	...	29.23	KCl+K ₂ SO ₄
-3	...	16.25	10.03	6.21	...	K ₂ Na(SO ₄) ₂ +Na ₂ SO ₄ .10H ₂ O
-3	...	16.24	10.03	6.21	...	K ₂ Na(SO ₄) ₂ +K ₂ SO ₄
-14	...	1.39	25.59	8.78	32.94	K ₂ Na(SO ₄) ₂ +Na ₂ SO ₄ .10H ₂ O+KCl
-14	...	1.39	25.59	8.78	32.94	K ₂ Na(SO ₄) ₂ +K ₂ SO ₄ +KCl
-23.3	...	0.41	15.15	44.20	58.97	Na ₂ SO ₄ .10H ₂ O+KCl+NaCl.2H ₂ O

* Indicates transition points.

EQUILIBRIUM IN THE SYSTEM POTASSIUM CHLORIDE, POTASSIUM SULFATE, SODIUM CHLORIDE, SODIUM SULFATE AND WATER AT DIFFERENT TEMPERATURES:
 (Blasdale, 1918.)

Saturation was secured by constant stirring at constant temperature.

Results at 25°.

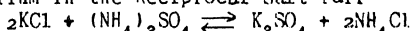
d of sat. sol.	Gms. per 100 gms. H ₂ O.				Solid Phase.
	KCl.	K ₂ SO ₄ .	NaCl.	Na ₂ SO ₄ .	
1.212	-	-	-	27.93	Na ₂ SO ₄
1.088	-	12.02	-	-	K ₂ SO ₄
1.187	36.96	-	-	-	KCl
1.199	-	-	35.63	-	NaCl
1.282	-	9.31	-	30.97	Na ₂ SO ₄ + K ₂ Na(SO ₄) ₂ (Glaserite)
1.149	-	13.24	-	6.69	K ₂ SO ₄ + "
1.190	36.63	1.53	-	-	" + KCl
1.237	16.28	-	29.88	-	NaCl + "
1.239	-	-	32.19	9.81	" + Na ₂ SO ₄
1.243	-	-	18.82	21.68	Na ₂ SO ₄ .10H ₂ O + "
1.273	-	7.32	14.28	22.28	" + " + K ₂ Na(SO ₄) ₂
1.200	29.38	2.23	6.78	-	KCl + K ₂ SO ₄ + "
1.250	16.37	-	27.96	3.51	" + NaCl + "
1.266	-	11.04	34.90	2.25	Na ₂ SO ₄ + " + "

Exactly similar results are also given for 0°, 50°, 75° and 100°.

Fusion-point data for mixtures composed of the various combinations, KCl, K₂SO₄, LiCl, Li₂SO₄, NaCl and Na₂SO₄, are given by Dombrowskaja and Klatchko, 1933.

POTASSIUM CHLORIDE

Equilibrium in the Reciprocal Salt Pair



in Water Alone and in Water Saturated with Ammonia at Atmospheric Pressure.

(Hill and Loucks, 1937.)

Results for the 3 component Systems in Water at 25°

Gms. per 100 gms. sat. solution				Solid Phase
$(\text{NH}_4)_2\text{SO}_4$	KCl	K_2SO_4	NH_4Cl	
—	26.42	—	—	KCl
—	25.90	1.05	—	" + K_2SO_4
—	0.0	10.80	—	K_2SO_4
10.36	—	9.59	—	(0.953 K_2SO_4 + 0.047 $(\text{NH}_4)_2\text{SO}_4$)
15.40	—	8.72	—	(0.925 " + 0.075 ")
28.31	—	6.12	—	(0.773 " + 0.227 ")
39.20	—	2.86	—	(0.195 " + 0.805 ")
43.42	—	—	—	$(\text{NH}_4)_2\text{SO}_4$
26.12	—	—	16.35	" + NH_4Cl
—	11.02	—	21.97	(0.166 NH_4Cl + 0.834 KCl) + (0.975 NH_4Cl + 0.025 KCl)
—	26.42	—	—	KCl

Results for the 3 component Systems in Water at 25°, sat. with NH_3 .

Gms. per 100 gms. sat. solution				Solid Phase
$(\text{NH}_4)_2\text{SO}_4$	KCl	K_2SO_4	NH_4Cl	
—	15.26	—	—	KCl
—	15.30	trace	—	" + K_2SO_4
—	0.0	0.20	—	K_2SO_4
2.85	—	—	—	(0.932 K_2SO_4 + 0.068 $(\text{NH}_4)_2\text{SO}_4$)
7.56	—	0.23	—	(0.776 " + 0.224 ")
11.35	—	—	—	(0.676 " + 0.324 ")
11.98	—	—	—	(0.525 " + 0.475 ")
13.54	—	0.20	—	(0.342 " + 0.658 ")
14.97	—	—	—	(0.186 " + 0.814 ")
17.55	—	0.07	—	(0.083 " + 0.917 ")
18.4	—	0	—	$(\text{NH}_4)_2\text{SO}_4$
4.66	—	—	33.72	" + NH_4Cl
—	—	—	35.59	NH_4Cl
—	2.86	—	33.59	(0.158 NH_4Cl + 0.842 KCl) + (0.977 NH_4Cl + 0.023 KCl)

The results in parentheses show the composition of the solid solutions present as solid phases.

The authors also give results for the 4 component systems saturated with solid phases composed of mixtures of the three solid solutions of the salts. They also investigated, for the purpose of industrial preparation of K_2SO_4 , the field in which this salt separates in order to learn what percentage of $(\text{NH}_4)_2\text{SO}_4$ accompanies it as a contamination.

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SOLUBILITY OF POTASSIUM CHLORIDE IN AQUEOUS SOLUTIONS
OF MAGNESIUM CHLORIDE AT 0° AND VICE VERSA.

(Tjelsrud, and Thompson, 1936.)

Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase
MgCl ₂	KCl		MgCl ₂	KCl	
0.0	21.87	KCl	26.79	2.12	KCl + 1.1.6
5.88	15.21	"	27.03	1.68	1.1.6
9.49	11.70	"	29.70	0.49	"
16.33	6.31	"	34.68	0.026	" + MgCl ₂ ·6H ₂ O
25.24	2.35	"	34.63	0.0	MgCl ₂ ·6H ₂ O

1.1.6 = KCl.MgCl₂·6H₂O (Carnallite)SOLUBILITY OF POTASSIUM CHLORIDE IN AQUEOUS MAGNESIUM
CHLORIDE SOLUTIONS.

(Precht and Wittgen -- Ber. 14, 1667, '81.)

Grams KCl per 100 Grams Sat. Solution in:

Cl

t°.	11.0%	15.0%	21.2%	30.0%	20.0% MgCl ₂
	MgCl ₂	MgCl ₂	MgCl ₂	MgCl ₂	
10	14.3	9.9	5.3	1.9	4.2 KCl + 5.7 NaCl
20	15.9	11.3	6.5	2.6	6.0 " + 5.9 "
30	17.5	12.7	7.6	3.4	6.9 " + 6.0 "
40	19.0	14.2	8.8	4.2	7.9 " + 6.1 "
50	20.5	15.6	10.0	5.0	8.9 " + 6.3 "
60	21.9	17.0	11.2	5.8	9.9 " + 6.4 "
80	24.5	19.5	13.6	7.3	10.9 " + 6.6 "
90	25.8	20.8	14.7	8.1	11.9 " + 6.7 "
100	27.1	22.1	15.9	8.9	13.0 " + 6.9 "

More recent data on the solubility of potassium chloride in aqueous solutions of magnesium chloride are given by Feit and Przibylla (1909).

SOLUBILITY OF POTASSIUM CHLORIDE IN AQUEOUS SOLUTIONS
OF MAGNESIUM CHLORIDE AT 100°.

(Campbell, Downes and Samis, 1934.)

Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase
MgCl ₂	KCl		MgCl ₂	KCl	
0.0	36.0	KCl	24.80	9.60	KCl
4.35	29.80	"	29.89	5.15	" + 1.1.6
9.93	23.59	"	40.0	1.88	1.1.6
16.35	17.50	"	40.0	1.64	"
20.15	13.45	"	41.0	0.73	" + MgCl ₂ ·6H ₂ O

1.1.6 = KCl.MgCl₂·6H₂O (Carnallite).

Results for the four component system KCl + K₂SO₄ + MgCl₂ + MgSO₄ at 100° are also given by Campbell, Downes and Samis, 1934.)

**EQUILIBRIUM IN THE SYSTEM MAGNESIUM CHLORIDE, POTASSIUM CHLORIDE
AND WATER AT DIFFERENT TEMPERATURES. (Keitel, 1923.)**

Gms. per 100 gms. sat. sol.				Gms. per 100 gms. sat. sol.			
t°.	Mg Cl ₂ .	K Cl.	Solid Phase.	t°.	Mg Cl ₂ .	K Cl.	Solid Phase.
15...	35.10	0.0	Bischofite	55...	15.14	14.79	K Cl
15...	27.59	2.76	K Cl + Carnallite	55...	7.24	23.40	»
15...	23.83	5.49	K Cl	83...	39.80	0.0	Bischofite
15...	16.57	10.73	»	83...	37.80	1.01	» + Carnallite
15...	7.66	17.66	»	83...	36.99	2.52	Carnallite
25...	35.60	0.0	Bischofite	83...	29.45	5.80	» + K Cl
25...	35.14	0.5	» + Carnallite	83...	20.53	12.75	K Cl
25...	27.70	3.70	K Cl »	83...	14.63	18.31	»
25...	26.81	4.56	K Cl	83...	14.77	18.27	»
25...	24.58	5.22	»	83...	7.15	26.85	»
25...	23.10	6.06	»	105...	43.47	0.0	Bischofite
25...	16.40	10.36	»	105...	40.75	1.07	» + Carnallite
25...	15.64	11.54	»	105...	36.51	3.62	Carnallite
25...	7.68	19.50	»	105...	30.82	7.00	» + K Cl
55...	37.55	0.0	Bischofite	105...	21.44	14.83	K Cl
55...	37.38	0.21	»	105...	14.08	21.72	»
55...	36.88	0.62	» + Carnallite	105...	13.97	21.87	»
55...	28.74	4.43	K Cl »	105...	6.52	29.90	»
55...	22.72	9.79	K Cl	105...	0.0	36.45	»

Bischofite = Mg Cl₂ · 6 H₂O ; Carnallite = Mg Cl₂ · K Cl · 6 H₂O.

The following determinations at 25° are reported by Lee and Egerton, 1923.

d_{25}^{25} of sat. sol.	Gms. per 100 gms. sat. sol.		Solid Phase.	d_{25}^{25} of sat. sol.	Gms. per 100 gms. sat. sol.		Solid Phase.
	Mg Cl ₂ .	K Cl.			Mg Cl ₂ .	K Cl.	
1.341	35.54	0.0	Mg Cl ₂ · 6 H ₂ O	—	26.79	3.20	K Cl + Carnallite
—	35.14	0.53	» + Carnallite	—	26.66	3.19	»
—	35.13	0.38	» »	1.234	19.83	7.90	K Cl
—	35.47	0.52	» »	1.201	12.11	13.56	»
—	26.81	3.33	K Cl »	1.182	0.0	26.74	»

POTASSIUM CHLORIDE

EQUILIBRIUM IN THE SYSTEM POTASSIUM CHLORIDE, MAGNESIUM CHLORIDE
AND WATER AT TEMPERATURES ABOVE 100°.

(Achoznov and Vassilijew, 1939.)

d. of sat. sol.	Gms. per 1000 gms. H ₂ O		Solid Phase	d. of sat. sol.	Gms. per 1000 gms. H ₂ O		Solid Phase
	MgCl ₂	KCl			MgCl ₂	KCl	
Results at 100°				Results at 150°			
—	100	415	KCl	—	100	558	KCl
—	300	220	"	—	300	347	"
—	500	108	"	—	500	214	"
—	700	10	"	—	900	105	"
1.307	507	103	" + 1.1.6	1.381	364	90	" + 1.1.6
1.384	723	9	1.1.6 + MgCl ₂ · 4H ₂ O	1.435	1054	37	1.1.6 + MgCl ₂ · 4H ₂ O
				1.455	1178	46 (167°)	KCl + MgCl ₂ · 4H ₂ O
Results at 125°				Results at 200°			
—	100	480	KCl	—	100	687	KCl
—	300	280	"	—	300	454	"
—	500	160	"	—	500	294	"
—	700	82	"	—	900	162	"
1.335	690	100	" + 1.1.6	—	900	162	"
1.430	890	28	1.1.6 + MgCl ₂ · 4H ₂ O	1.472	1290	54	" + MgCl ₂ · 2H ₂ O

1.1.6 = KCl · MgCl₂ · 6H₂O (Carnallite)

The authors also give results for the system KCl + NaCl + MgCl₂ + H₂O at 100-200°.

Data for the System KCl + MgCl₂ + NaCl + MgSO₄ at 20°-200° + are given by Froehlich, 1929.

Data for the reciprocal Salt pairs (KCl)₂ + MgBr₂ <—> (KBr)₂ + MgCl₂, at 20°, recalculated from the results of Boeke, 1908, are given by Jänecke, 1938.

Data for the System KCl + RbCl + MgCl₂ + H₂O at 25°, recalculated from the results of D'Ans and Bush, 1937, are given by Jänecke, 1937, 1938.

SOLUBILITY OF MIXTURES OF POTASSIUM CHLORIDE AND AMMONIUM CHLORIDE IN WATER AT 25°.

(Fock — Z. Kryst. Min. 28, 353, '97.)

Grams per Liter Solution.		Mol. per cent in Solution.		Sp. Gr. of Solutions.	Mol. per cent in Solid Phase.	
NH ₄ Cl	KCl	NH ₄ Cl	KCl		NH ₄ Cl	KCl
0.00	311.3	0.00	100.0	1.1807	0.0	100
22.81	293.3	9.41	90.59	1.1716	1.21	98.79
35.39	278.7	15.04	84.96	1.1678	2.11	97.89
89.17	273.2	34.26	65.74	1.1591	6.18	93.82
127.8	234.6	46.59	53.44	1.1493	8.90	91.10
147.2	204.2	51.63	48.37	1.1461	10.53	89.47
197.3	157.7	63.56	36.44	1.1391	17.86	82.14
232.5	116.8	73.49	26.51	1.1326	60.20	39.80
244.5	123.0	73.48	26.52	1.1329	76.88	23.12
261.9	111.0	79.10	20.90	1.1245	97.51	2.49
259.0	102.2	82.14	17.86	1.1212	97.79	2.21
278.6	53.16	87.96	12.04	1.1009	98.85	1.15
320.7	31.24	93.45	6.55	1.0912	99.33	0.67
273.5	0.00	100.00	0.00	1.0768	100.0	0.00

The following additional data for the above system are given by Biltz and Marcus (1911). The results show that NH₄Cl + KCl form a series of mix-crystals broken by a gap which extends between about 20 and 98 mol. per cent NH₄Cl in the crystals.

Composition of Sat. Solution.				Composition of Solid Phase.		
Gms. per 100 Gms. Sat. Sol.		Mols. per 1000 Mols. H ₂ O.		Gms. per 100 Gms. Crystals.		Mol. % NH ₄ Cl in Crystals.
NH ₄ Cl.	KCl.	NH ₄ Cl.	KCl.	NH ₄ Cl.	KCl.	
5.13	22.29	23.8	74.2	1.21	98.79	1.7
7	20.40	32.5	67.9	2.22	97.78	3.1
11	18.04	52.2	61.4	4	96	5.5
13.73	16.11	65.9	55.5	5.89	94.11	8
15.46	14.53	74.4	50.2	7.24	92.76	9.8
19.54	12.16	96.3	43	11.20	88.80	14.9
22.04	10.49	109	37.4	16.90	83.10	22.1
21.68	10.40	109	37.4	26.04	73.96	32.9
21.95	10.48	109	37.4	97.60	2.40	98.3
24.30	6.48	118.2	22.6	98.28	1.72	98.8

These authors also give data for the ammonium chloride carnallite and potassium chloride carnallite diagram at 25°.

SOLUBILITY OF MIXTURES OF AMMONIUM AND POTASSIUM CHLORIDES IN WATER AT 25°, 65° AND 90°.

(Uyeda, 1912.)

The results as presented by Uyeda show the percentage composition of the dissolved mixture and of the undissolved residue in the several cases, but not the quantity of salts dissolved. Mixed crystals were formed over certain ranges of concentration at each temperature.

Data for the cryohydric temperatures and composition of the saturated solutions of mixtures of the chlorides, nitrates and sulfates of ammonium, potassium and sodium are given by Mazatto (1891).

EQUILIBRIUM IN THE SYSTEM POTASSIUM CHLORIDE, AMMONIUM CHLORIDE AND WATER.

(Jänecke, 1929.)

The Jänecke method of expressing the concentration of the saturated solution is in terms of the number of Gm. Mols. H_2O required to dissolve 100 gm. mols. salt or salt mixture of the determined molecular composition.

In the present case the salts form mixed crystals and the solid phases in contact with the solutions are composed of such mixed crystals containing varying percentages of the two salts.

Composition of dissolved salts in gm. mols.		Gm. Mols. H_2O to dissolve 100 gm. mols. salt mixture	Solid Phase
KCl	NH_4Cl		
Results at 0°			
100	0.0	1430	100 Mol. % KCl
80	20	1330	95 " " (1)
60	40	1200	90 " " (1)
40	60	1030	84 " " (1)
28.5	71.5	950	81 " + 95.5 Mol. % NH_4Cl
20	80	990	96.5 " (1)
0	100	1000	100 "
Results at 20°			
100	0.0	1210	100 Mol. % KCl
80	20	1090	? " "
60	40	970	? " "
40	60	840	? " "
27.5	72.5	740	75 " + 95 Mol. % NH_4Cl
20	80	720	? Mol. % NH_4Cl
0	100	800	100 "
Results at 40°			
100	0.0	1030	100 Mol. % KCl
80	20	920	? " "
60	40	820	? " "
40	60	750	? " "
26	74	620	66 " + 93.5 Mol. % NH_4Cl
20	80	620	? Mol. % NH_4Cl
0	100	650	100 "
Results at 60°			
100	0.0	905	100 Mol. % KCl
80	20	760	? " "
60	40	650	? " "
40	60	550	? " "
24	76	510	54 " + 91 Mol. % NH_4Cl
20	80	520	? Mol. % NH_4Cl
0	100	540	100 "
Results at 80°			
100	0.0	810	100 Mol. % KCl
20	80	430	38 " + 90 Mol. % NH_4Cl
0	100	450	100 Mol. % NH_4Cl
Results at 100°			
100	0.0	730	100 Mol. % KCl
15.5	84.5	360	28 " + 91 Mol. % NH_4Cl
0	100	390	100 Mol. % NH_4Cl

(1) These values by Askenasy and Nessler, 1930.

Jänecke also gives similar results for equilibrium in the system composed of the reciprocal salt pair $KCl + NH_4NO_3 \rightleftharpoons NH_4Cl + KNO_3$. Askenasy and Nessler, 1930, give results for the quaternary system (K NH)

SOLUBILITY OF POTASSIUM CHLORIDE IN AQUEOUS SOLUTIONS OF AMMONIA.

(Guyer, Bieler and Schmid, 1934.)

The authors present their results in the form of a diagram but do not give their experimental determinations. The following approximate values were estimated from the published diagram.

Results at -15°			Results at $+25^{\circ}$		
Gms. per 100	gms. sat. sol.	Solid Phase	Gms. per 100	gms. sat. sol.	Solid Phase
NH_3	KCl		NH_3	KCl	
55	4.0	KCl	62	4.0	KCl
60	3.1	"	70	2.4	"
70	1.7	"	80	1.3	"
80	0.8	"	90	0.5	"
90	0.35	"	100	0.1	"
100	0.2	"			

SOLUBILITY OF POTASSIUM CHLORIDE IN LIQUID AMMONIA
DETERMINED BY THE SYNTHETIC METHOD.

(Patschke and Tanne, 1935.)

t°	Gms. KCl per 100 gms. sat. sol.	Solid Phase	t°	Gms. KCl per 100 gms. sat. sol.	Solid Phase
-76.6	0.078	NH ₃	-33.9	0.213(1)	KCl
-76.6	0.115	"	-19.4	0.167	"
-76.7	0.167	"	- 0.6	0.141	"
-76.8	0.193	"	0.0	0.132(2)	"
-76.9	0.209	"	+15.0	0.115	"
-77.0	0.219	"	25	0.04 (3)	"
-77.2	0.252	NH ₃ + KCl	18.9	0.102	"
-57.9	0.219	KCl	31.2	0.089	"
-45.0	0.209	"	44.2	0.078	"
-35.2	0.193	"			

The authors also give results showing that the solubility of KCl in liquid ammonia is increased to almost double by the presence of NaCl or of NH_4Cl .

(1) Johnson and Krumboltz, 1933; (2) Linhard and Stephan, 1933-1934;
(3) Hunt, 1932.

THE SOLUBILITY OF POTASSIUM CHLORIDE IN AQUEOUS SOLUTIONS OF MIXTURES
OF OTHER SALTS.

The polytherms of the four salt points of the potassium chloride field in quinary systems of oceanic salt deposits have been redetermined with great care by Dr. Serowy, 1923. This is a repetition and extension of the fundamental work of Van't Hoff, D'Ans and others. Results at temperatures between 0° and 120° are given for the equilibrium solution Q (Van't Hoff) in contact with K Cl + Na Cl + carnallite + kainite, or kieserite; at temperatures between 60.5° and 120° for the equilibrium solution P in contact with K Cl + Na Cl + glaserite + langbeinite; between 0° and 120° for the equilibrium solution F in contact with K Cl + Na Cl + glaserite; between 0° and 120° for the equilibrium solution E in contact with K Cl + Na Cl + carnallite and between 23° and 120° for the equilibrium solution R in contact with Na Cl + kainite + kieserite + carnallite and with K Cl + Na Cl + kieserite + langbeinite. For additional references see also magnesium chloride.

SOLUBILITY OF POTASSIUM CHLORIDE IN AQUEOUS SOLUTIONS OF
SODIUM CHLORIDE AND VICE VERSA.

(Cornec and Krumbach, 1939.)

t°	d. of sat. sol.	Gms. per 100 gms. sat. sol.		Solid Phase
		KCl	NaCl	
-22.9	—	5.81	20.17	Ice + KCl + NaCl.2H ₂ O
-21.8	—	2.60	21.71	" + NaCl.2H ₂ O
-21.1	—	—	23.07	" + "
-17.8	—	9.01	14.40	" + KCl
-13.7	—	13.64	7.59	" "
-10.7	—	19.54	—	" "
-11.9	—	6.49	21.41	KCl + NaCl.2H ₂ O
-10.0	—	—	24.70	NaCl.2H ₂ O
- 2.3	—	6.96	22.54	" + NaCl + KCl
+ 0.1	—	—	26.27	" + "
0	1.154	21.92	0.0	KCl
"	1.175	16.09	7.67	"
"	1.200	14.39	14.82	"
"	1.221	8.46	20.03	"
"	1.234	7.28	22.40	" + NaCl
"	1.226	5.10	23.52	NaCl
Cl	1.218	2.58	24.86	"
"	1.209	0.0	26.25	"
10	1.233	8.71	21.66	KCl + NaCl
20	1.174	25.57	0.0	"
"	1.190	19.48	7.36	"
"	1.210	14.29	14.40	"
"	1.221	12.24	17.64	"
"	1.234	10.19	20.03	" + NaCl
"	1.223	6.98	22.65	NaCl
"	1.213	3.54	24.47	"
"	1.201	0.0	26.34	"
30	1.235	11.70	20.25	KCl + NaCl
40	1.189	28.65	0.0	"
"	1.201	22.44	7.19	"
"	1.218	17.05	14.04	"
"	1.236	13.16	19.66	" + NaCl
"	1.221	8.94	21.87	NaCl
"	1.207	4.62	24.15	"
"	1.192	0.0	26.64	"
50	1.237	14.70	19.02	KCl + NaCl
60	1.199	31.29	0.0	"
"	1.210	25.14	6.90	"
"	1.224	19.79	13.52	"
"	1.238	16.07	18.57	" + NaCl
"	1.220	10.97	21.17	NaCl
"	1.202	5.71	23.94	"
"	1.184	0.0	27.03	"
70	1.239	17.59	18.05	KCl + NaCl
80	1.205	33.59	0.0	"
"	1.216	27.59	6.79	"
"	1.229	22.34	13.17	"
"	1.241	19.03	17.59	" + NaCl
"	1.223	14.10	20.03	NaCl
"	1.199	7.38	23.53	"
"	1.175	0.0	27.51	"

POTASSIUM CHLORIDE

SOLUBILITY OF POTASSIUM CHLORIDE IN AQUEOUS SOLUTIONS OF
SODIUM CHLORIDE AND VICE VERSA. (Con.)
(Cornec and Krombach, 1932.)

t°	d. of sat. sol.	Gms. per 100 gms. sat. sol.		Solid Phase
		KCl	NaCl	
90	1.242	20.32	17.24	KCl + NaCl
100	1.209	35.69	0.0	"
"	1.219	29.95	6.48	"
"	1.232	24.88	12.69	"
"	1.244	21.68	16.90	" + NaCl
"	1.232	19.12	18.12	NaCl
"	1.200	10.25	22.57	"
"	1.166	0.0	28.00	"
110	1.245	23.04	16.58	KCl + NaCl

Results for the b. pts.

108.5	1.209	36.50	0.0	KCl
111.9	1.246	23.28	16.52	" + NaCl
108.7	1.162	0.0	28.30	NaCl

The above determinations for the solutions simultaneously saturated with KCl + NaCl are in good agreement with the values reported by Blasdale, 1918, but not with those of the earlier workers including Precht & Wittgen, 1881; Etard, 1897; Leather and Mukerje, 1913; Reinders, 1915; and D'Ans, 1915. The more recent determinations of the system at 20° by Di Capua and Scaletti, 1927, are in satisfactory agreement with the above results.

Cl

SOLUBILITY OF POTASSIUM CHLORIDE IN AQUEOUS SOLUTIONS OF
SODIUM CHLORIDE AND VICE VERSA AT TEMPERATURES ABOVE THE BOILING POINTS.
(Cornec and Krombach, 1932.)

The determinations were made in a small moxydizable steel autoclave in which Jena glass receptacles were fitted in such a manner that the solution after saturation in one by gentle agitation could be filtered into the other by inverting the autoclave.

t°	Gms. per 100 gms. sat. sol.		Solid Phase	t°	Gms. per 100 gms. sat. sol.		Solid Phase	t°	Gms. per 100 gms. sat. sol.		Solid Phase
	KCl	NaCl			KCl	NaCl			KCl	NaCl	
120	37.65	0.0	KCl	140	19.07	19.61	NaCl	169.5	8.68	25.93	NaCl
"	32.28	6.24	"	"	9.98	24.13	"	"	0.0	30.62	"
"	27.33	12.25	"	"	0.0	29.30	"	189.6	44.34	0.0	KCl
"	24.23	16.35	" + NaCl	149	27.44	16.08	" + KCl	"	39.36	5.68	"
"	17.29	19.69	NaCl	169.5	42.42	0.0	KCl	"	35.44	10.86	"
"	9.48	23.66	"	"	37.24	5.92	"	"	33.38	13.64	"
"	0.0	28.60	"	"	33.04	11.41	"	"	31.74	16.33	" + NaCl
130	25.29	16.33	" + KCl	"	30.72	14.52	"	"	25.58	18.78	NaCl
140	39.60	0.0	KCl	"	29.63	16.03	" + NaCl	"	18.36	22.01	"
"	34.43	6.17	"	"	23.38	18.78	NaCl	"	9.88	26.13	"
"	29.71	11.86	"	"	15.24	22.66	"	"	0.0	31.45	"
"	26.45	16.17	" + NaCl	"							

K KALIUM POTASSIUM CHLORIDE

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SOLUBILITY OF POTASSIUM CHLORIDE IN AQUEOUS SOLUTIONS OF SODIUM CHLORIDE AND VICE VERSA AT TEMPERATURES ABOVE 100°. (Ackoumow and Wassilijew, 1939.)

t°	d. of sat. sol.	Gms. per 1000 KCl	Gms. H ₂ O NaCl	Solid Phase	t°	d. of sat. sol.	Gms. per 1000 KCl	Gms. H ₂ O NaCl	Solid Phase
100	—	480	100	KCl	170	1.305	543	293	KCl+NaCl
"	—	440	150	"	180	1.318	577	300	" "
"	—	400	200	"	190	1.330	614	309	" "
"	—	360	250	"	200	—	743	100	" "
"	1.245	359	257	" +NaCl	"	—	708	150	" "
"	—	300	280	NaCl	"	—	682	200	" "
110	1.255	390	259	KCl+NaCl	"	—	661	250	" "
120	1.264	415	265	" "	"	1.340	650	319	" +NaCl
130	1.274	440	270	" "	"	—	600	322	NaCl
140	1.282	465	275	" "	"	—	500	340	" "
150	—	606	100	"	"	—	400	364	" "
"	—	570	150	"	"	—	300	389	" "
"	—	533	200	"	220	—	698	332	KCl+NaCl
"	—	500	250	"	230	—	722	338	" "
"	1.289	486	280	" +NaCl	250	—	769	351	" "
"	—	400	303	NaCl	270	—	817	374	" "
"	—	300	333	"	280	—	847	382	" "
Cl 160	1.295	508	285	KCl+NaCl	300	—	900	400	" "

SOLUBILITY OF POTASSIUM CHLORIDE IN AQUEOUS SOLUTIONS OF SODIUM CHLORIDE AND VICE VERSA AT 18.5°.

(Hollata and Moutner, 1927.)

To standard solutions of one of the salts an excess of the other salt was added and the mixtures heated to 60° and then cooled and shaken at 18.5°, until equilibrium was attained. A given volume of the saturated solution was evaporated to dryness and from the weight of the residue, the concentration of the original aqueous solvent and the densities of the original solvent and final saturated solution, the weight of each salt present in 100cc. of the saturated solution was calculated. The results thus obtained agreed satisfactorily with calculations based upon chloride determinations.

Gm. Mols. NaCl per liter aq. solvent	d. of sat. sol.	Gms. per 1000 cc. sat. sol. NaCl KCl	Gm. Mols. KCl per liter aq. solvent	d. of sat. sol.	Gms. per 1000 cc. sat. sol. KCl NaCl
0.0	1.1738	0.00 298.50	0.0	1.2019	0.0 316.30
0.2	1.1752	10.26 290.50	0.2	1.2055	13.24 310.10
0.4	1.1766	20.62 281.58	0.4	1.2090	26.54 304.64
0.6	1.1792	31.06 273.14	0.6	1.2132	39.90 297.90
1.0	1.1840	52.18 256.74	1.0	1.2194	66.72 284.50
3.0	1.2070	161.72 179.44	1.5	1.2283	100.66 268.02
4.66	1.2343	257.22 124.16	1.837	1.2343	124.16 257.22

SOLUBILITY OF POTASSIUM CHLORIDE IN AQUEOUS SOLUTIONS OF SODIUM CHLORIDE AND VICE VERSA.

(Leather and Mukerji, 1913; see also Nicol, 1891.)

Results at 20°.			Results at 40°.			Results at 91°.			Solid Phase in Each Case.
Sp. Gr. Sat. Sol.	Gms. per 100 Gms. H ₂ O.		Sp. Gr. Sat. Sol.	Gms. per 100 Gms. H ₂ O.		Sp. Gr. Sat. Sol.	Gms. per 100 Gms. H ₂ O.		
	KCl.	NaCl.		KCl.	NaCl.		KCl.	NaCl.	
I. 176	34.61	o	I. 194	40.60	o	I. 222	53.58	o	KCl
I. 197	26.60	10.13	I. 207	31.42	10.68	I. 236	45.01	10.66	"
I. 213	19.65	20.61	I. 235	24.43	20.99	I. 262	35.84	22.87	"
I. 237	14.92	30.36	I. 248	18.23	30.60	I. 262	33.12	28.12	"
I. 240	15.36	29.61	I. 242	18.74	30.32	I. 264	32.45	28.26	" + NaCl
I. 233	14.76	30.38	I. 247	19.13	29.92	I. 235	27.15	29.18	NaCl
I. 224	9.70	32.40	I. 222	10.49	32.59	I. 223	13	33.93	"
I. 193	o	35.63	I. 197	o	36.53	I. 180	o	38.72	"

Results are also given for 30°.

For results in the systems Potassium Chloride, Lead Chloride and Water see under PbCl₂.

SOLUBILITY OF POTASSIUM CHLORIDE IN AQUEOUS SOLUTIONS OF RUBIDIUM CHLORIDE AT 25°.

(D'Ans and Bush, 1937.)

Gm. Mols. per 1000 gm. Mols. H ₂ O		Solid Phase Mixed crystals containing:	Gm. Mols. per 1000 gm. Mols. H ₂ O		Solid Phase Mixed crystals containing:
Rb ₂ Cl ₂	K ₂ Cl ₂		Rb ₂ Cl ₂	K ₂ Cl ₂	
0	43.5	100 Mol. % K ₂ Cl ₂	41.2	22.5	67.3 Mol. % K ₂ Cl ₂
10.0	37.6	97.6 "	51.0	17.5	41.8 "
19.2	33.5	92.6 "	59.3	10.4	15.5 "
31.0	28.0	84.5 "	70.1	0.0	0 "

Results are also given for the quaternary System KCl + RbCl + MgCl₂ at 25°.

SOLUBILITY OF POTASSIUM CHLORIDE IN AQUEOUS SOLUTIONS OF STANNOUS CHLORIDE AT 25° AND VICE VERSA. (Fujimura, 1914.)

Gms. per 100 Gms. H ₂ O.		Solid Phase.	Gms. per 100 Gms. H ₂ O.		Solid Phase.
SnCl ₂ .	KCl.		SnCl ₂ .	KCl.	
0	34.73	KCl	58.48	17.85	SnCl ₂ .KCl.H ₂ O
2.86	32.17	"	81.78	19.06	"
4.37	34.08	"	107.65	17.79	"
5.95	31.76	SnCl ₂ .2KCl.2H ₂ O	170.70	21.26	"
5.83	30.65	"	247.50	24.38	"
10.24	27.30	"	337.26	25.51	"
17.42	24.68	"	290.30	19.66	SnCl ₂ .2H ₂ O
27.88	24.40	"	235.50	7.49	"
34.28	5.99	"	222.5	2.73	"
54.19	19.45	SnCl ₂ .KCl.H ₂ O	234.05	...	"

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SOLUBILITY OF POTASSIUM CHLORIDE IN DILUTE AQUEOUS SOLUTIONS OF
METHYL ALCOHOL AT 0° AND AT 25°.

(Armstrong and Eyre, 1910-11.)

Wt. % CH ₃ OH in Solvent.	Gms. KCl per 100 Gms. Sat. Sol. at:	
	0°.	25°.
0	22.06	26.69
0.79	21.74	26.42
1.57	21.39	26.01
3.10	20.61	25.25
8.76	17.84	22.82

SOLUBILITY OF POTASSIUM CHLORIDE IN AQUEOUS METHYL ALCOHOL AT 25°.

(Herz and Anders, 1907; McIntosh, 1903.)

Solvent.			Solvent.		
d_{25}^4	Wt. % CH ₃ OH.	d_{25}^4 of Sat. Sol.	d_{25}^4	Wt. % CH ₃ OH.	d_{25}^4 of Sat. Sol.
0.9971	0	1.1782	0.8820	64	0.9064
0.9791	10.6	1.125	0.8489	78.1	0.8607
0.9481	30.8	1.033	0.8167	98.9(?)	0.8242
0.9180	47.1	0.9679	0.7882	100	0.7937

100 gms. methyl alcohol dissolve 0.53 gm. KCl at 25°. (Turner and Bisett, 1913.)

ethyl	"	"	0.022	"	"	"	"
propyl	"	"	0.004	"	"	"	"
amyl	"	"	0.0008	"	"	"	"

Cl

Potassium chloride is insoluble in CH₃OH at the crit. temp. (Centnersawer, 1910.)

SOLUBILITY OF POTASSIUM CHLORIDE IN AQUEOUS
SOLUTIONS OF METHYL ALCOHOL AT 25°.

(Akerlof and Turck, 1946.)

Composition of Solvent in		Gm. Mols. KCl per 1000 gms. Solvent	Composition of Solvent in		Gm. Mols. KCl per 1000 gms. Solvent
Wt. % CH ₃ OH	Mol. frac. CH ₃ OH		Wt. % CH ₃ OH	Mol. frac. CH ₃ OH	
0.0	0.000	4.826	59.28	0.4502	0.6487
11.10	0.0656	3.638	69.74	0.5645	0.3766
20.11	0.1240	2.820	78.98	0.6787	0.2193
29.87	0.1933	2.077	80.45	0.6983	0.2005
39.93	0.2721	1.476	90.04	0.8248	0.1135
50.65	0.3661	0.9561	100.00	1.0000	0.0707

SOLUBILITY OF POTASSIUM CHLORIDE IN AQUEOUS SOLUTIONS
OF ETHYL AND METHYL ALCOHOL.

(Zelinka, 1928.)

Solvent		Gm. mols. KCl per liter at		Gms. per 1000 cc sat. sol.	
		10°.	15°.	10°.	15°.
Water		3.712	3.903	—	—
Aq. 25.96 Wt. % CH ₃ OH		1.700	1.896	126.3	141.4
" 45.13 "		0.8403	0.8700	62.65	64.87
" 74.88 "		0.1886	0.2121	14.06	15.81
" 100.00 "		0.0520	0.0560	3.88	4.18
" 25.07 % Wt. C ₂ H ₅ OH		1.607	1.755	119.8	130.9
" 50.01 "		0.5860	0.6004	43.66	44.77
" 75.03 "		0.1127	0.1245	8.4	9.28
" 97.3 "		0.00	0.0052	—	0.39

100 gms. aqueous 50 wt. percent C₂H₅OH solution dissolve 6.0 gms. KCl at 20° and 15.3 gms. at 100°. (Wright, 1927.)

100 gms. 40 wt. per cent alcohol dissolve 5.87 gms. KCl + 12.25 gms. NaCl at 25°.
 100 gms. 40 wt. per cent alcohol dissolve 5.29 gms. KNO₃ + 10.06 gms. KCl at 25°.
 (Soch, 1898.)

100 gms. abs. ethyl alcohol dissolve 0.034 gm. KCl at 18.5°.

100 gms. abs. methyl alcohol dissolve 0.5 gm. KCl at 18.5°.

(de Bruyn, 1892; Rohland, 1898.)

SOLUBILITY OF POTASSIUM CHLORIDE IN DILUTE SOLUTIONS OF ETHYL ALCOHOL AT 0° AND AT 25°.

(Armstrong, Eyre, Hussey and Paddison, 1907; Armstrong and Eyre, 1910-11.)

Wt. % C ₂ H ₅ OH in Solvent.	Gms. KCl Dissolved per 100 Gms. Sat. Sol. at:		d_{25}^{20} of Sol. Sat.
	0°.	25°.	
0	22.1	26.44	1.1813
1.14	21.6	25.91	1.1754
2.25	20.9	25.29	1.1680
4.41	19.7	24.21	1.1568
8.44	...	22.46	1.1357
12.13	15.5	...	...
18.69	...	17.42	1.0847

SOLUBILITY OF POTASSIUM CHLORIDE IN AQUEOUS ALCOHOL AT:

15°.

14.5°.

(Schiff — Liebig's Ann. 118, 365, '61.)

(Bodländer — Z. physik. Ch. 7, 316, '91.)

Sp. Gr. of Alcohol.	Wt. per cent Alcohol.	G. KCl per 100 g. Aq. Alcohol.	Sp. Gr. of Sat. Solutions.	Grams per 100 cc. Solution.		
				C ₂ H ₅ OH.	H ₂ O.	KCl.
0.984	10	19.8	1.1720	...	88.10	29.10
0.972	20	14.7	1.1542	2.79	85.78	26.85
0.958	30	10.7	1.1365	4.98	84.00	24.67
0.940	40	7.7	1.1075	10.56	79.63	20.56
0.918	50	5.0	1.1085	15.57	75.24	17.24
0.896	60	2.8	1.0545	20.66	70.52	14.27
0.848	80	0.45	1.0455	24.25	67.05	13.25
Gerardin's results at 15° agree well with the above deter- minations.			0.9695	40.42	50.18	6.35
			0.9315	48.73	40.60	3.82
			0.8448	68.63	15.55	0.30

30° and 40°.

(Bathrick — J. Physic. Chem. 1, 160, '06.)

Wt. per cent Alcohol.	Gms. KCl per 100 Gms. Aq. Alcohol.		Wt. per cent Alcohol.	Gms. KCl per 100 Gms. Aq. Alcohol.	
	At 30°.	At 40°.		At 30°.	At 40°.
0	38.9	41.8	43.1	11.1	13.1
5.28	33.9	35.9	55.9	6.8	8.2
9.43	30.2	33.3	65.9	3.6	4.1
16.9	24.9	27.6	78.1	1.3	1.6
25.1	19.2	21.8	86.2	0.4	0.5
34.1	15.6	17.2			

SOLUBILITY OF POTASSIUM CHLORIDE IN AQUEOUS ALCOHOL.
(Gerardin — Ann. chim. phys. [4] 5, 140, '65.)

Interpolated from the original results.

°.	Grams KCl per 100 Gms. Aq. Alcohol of Sp. Gr.:							
	0.9904 = 5.5 Wt. %.	0.9848 = 9.35 Wt. %.	0.9793 = 13.6 Wt. %.	0.9736 = 19.1 Wt. %.	0.9573 = 30 Wt. %.	0.939 = 40 Wt. %.	0.8967 = 60 Wt. %.	0.8244 = 90 Wt. %.
0	23.4	19.5	15.5	11.5	7.0	4.0	1.7	0.0
5	25.0	21.0	16.8	12.8	8.0	4.8	2.2	0.0
10	26.4	22.5	18.0	14.0	9.0	5.6	2.7	0.0
15	26.8	24.0	19.2	15.2	10.0	6.4	3.1	0.04
20	29.1	25.3	20.3	16.1	10.8	7.2	3.5	0.06
25	30.4	26.8	21.5	17.1	11.6	7.9	3.9	0.08
30	31.7	28.0	22.6	18.2	12.5	8.5	4.2	0.10
40	34.3	30.8	24.8	20.0	14.0	9.9	4.8	0.20
50	37.0	33.5	27.0	21.8	15.5	10.8	5.2	0.30
60	...	...	...	...	16.8	11.8	5.5	0.40

Cl

SOLUBILITY OF POTASSIUM CHLORIDE IN AQUEOUS SOLUTIONS OF ETHYL
ALCOHOL AT 25°.
(McIntosh, 1903.)

Wt. % C ₂ H ₅ OH.	Mols. KCl per Liter.	Gms. KCl per 100 cc. Sat. Sol.	Wt. % C ₂ H ₅ OH.	Mols. KCl per Liter.	Gms. KCl per 100 cc. Sat. Sol.
0	4.18	31.18	60	0.56	4.18
10	3.21	23.93	70	0.305	2.27
20	2.40	17.89	80	0.125	0.93
30	1.78	13.27	90	0.042	0.31
40	1.26	9.40	100	0.011	0.08
50	0.84	6.26			

SOLUBILITY OF POTASSIUM CHLORIDE IN AQUEOUS SOLUTIONS OF
ETHYL ALCOHOL AT DIFFERENT TEMPERATURES.

Results at 25°
(Flatt & Jordan, 1933.)

Results at 16°, 25° and 35°
(Ferner & Mellon, 1934.)

Wt. % C ₂ H ₅ OH in solvent	Gms. KCl per 100 gms. solvent	Wt. Percent C ₂ H ₅ OH in solvent	Gms. KCl per 100 gms. aq. solvent at:		
			16°	25°	35°
0.0	35.86	86.4	0.2256	0.2778	0.3134
20.4	19.70	89.6	0.1414	0.1743	0.1995
42.5	9.162	92.3	0.0862	0.1084	0.1207
67.9	2.278	96.9	0.0431	0.0500	0.0603
		100.0	0.0265	0.0288	0.0325

SOLUBILITY OF POTASSIUM CHLORIDE IN PURE ETHYL ALCOHOL SOLUTIONS
OF AMMONIUM NITRATE AT 25°.

(Seward and Schumb, 1930.)

Gm. Mols. NH_4NO_3 per liter solvent	Gm. Mols. KCl per liter sat. sol.	Gm. Mols. NH_4NO_3 per liter solvent	Gm. Mols. KCl per liter sat. sol.
0.000	0.003108 (= 0.2318 gm.)	0.004807	0.005020
0.000188	0.003125	0.008587	0.007229
0.000466	0.003141	0.01947	0.008827
0.000992	0.003327	0.05129	0.011131
0.002352	0.003716		

SOLUBILITY OF POTASSIUM CHLORIDE IN SEVERAL ALCOHOLS AT 25°.

(Larson and Hunt, 1939.)

Alcohol	Formula	d. of alcohol	d. of sat. solution	Gms. KCl dissolved per 100 gms. alcohol
Methanol	CH_3OH	0.7866	0.7907	0.5391
Ethanol	$\text{C}_2\text{H}_5\text{OH}$	0.7851	0.7852	0.0294
1-Propanol	$\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$	0.8001	0.7994	0.0061
1-Butanol	$\text{CH}_3(\text{CH}_2)_2\text{CH}_2\text{OH}$	0.8057	0.8058	0.0030
2-Propanol (iso)	$\text{CH}_3\text{CHOHCH}_3$	0.7810	0.7809	0.0023
2-Methyl-1-propanol	$(\text{CH}_3)_2\text{CHCH}_2\text{OH}$	0.7979	0.7980	0.0020
1-Pentanol	$\text{CH}_3(\text{CH}_2)_3\text{CH}_2\text{OH}$	0.8095	0.8096	0.0022
2-Butanol (iso)	$\text{CH}_3\text{CH}_2\text{CHOHCH}_3$	0.8025	0.8022	0.00084

SOLUBILITY OF POTASSIUM CHLORIDE IN SEVERAL ALCOHOLS
AT DIFFERENT TEMPERATURES.

(Kirm and Dunlap, 1931.)

t°	Gm. Mols. KCl per 100 gms. mols. of:					
	Methanol CH_3OH	Ethanol $\text{C}_2\text{H}_5\text{OH}$	Propanol $\text{C}_3\text{H}_7\text{OH}$	Iso Propanol $\text{C}_3\text{H}_7\text{OH}$	Butanol $\text{C}_4\text{H}_9\text{OH}$	Iso Butanol $\text{C}_4\text{H}_9\text{OH}$
20	0.833	0.1270	0.00700	0.1235	0.00822	0.00326
30	0.729	0.1378	0.00796	0.1300	0.00852	0.00356
35	0.691	0.1443	0.00793	0.1340	—	—
40	0.642	0.1454	0.00773	0.1390	0.00904	0.00400
45	0.528	0.1277	0.00683	0.1295	—	—
50	0.415	0.0845	0.00473	0.1060	0.00925	0.00407

SOLUBILITY OF POTASSIUM CHLORIDE IN DILUTE AQUEOUS SOLUTIONS OF
PROPYL ALCOHOL AT 0° AND AT 25°.

(Armstrong and Eyre, 1910-11.)

Wt. % $\text{C}_3\text{H}_7\text{OH}$ in Solvent.	Gms. KCl per 100 Gms. Sat. Sol. at:	
	0°.	25°.
I	22.06	26.44
I.48	21.25	25.94
2.91	20.49	25.23
5.66	18.97	23.82

POTASSIUM CHLORIDE

SOLUBILITY OF POTASSIUM CHLORIDE IN AQUEOUS SOLUTIONS OF
ISO PROPYL ALCOHOL AT 25°.
(Ginnings and Chen, 1931.)

The results locate the binodal curve of the systems and include a tie line * which shows the composition of two layers in contact with each other and the plait point, PP, at which the two liquid layers become homogenous.

Gms. per 100 gms. sat. solution		Gms. per 100 gms. sat. solution	
ISO C_3H_7OH	KCl	ISO C_3H_7OH	KCl
13.72	17.48*	36.14	9.17
17.64	15.17	37.50	8.93 PP
22.87	12.95	42.46	7.65
29.34	11.04	53.95	5.12

SOLUBILITY OF POTASSIUM CHLORIDE IN AQUEOUS SOLUTIONS OF
ISO PROPYL ALCOHOL AT DIFFERENT TEMPERATURES.
(Ferner and Mellon, 1934.)

Cl	Wt. Percent ISO C_3H_7OH in Solvent	Gms. KCl per 100 gms. aq. solvent at:		
		10°	25°	35°
	87.7	0.1095	0.1280	0.1494
	92.6	0.0286	0.0298	0.0364
	96.5	0.0074	0.0084	0.0104
	100.0	0.0026	0.0027	0.0029

SOLUBILITY OF POTASSIUM CHLORIDE IN AQUEOUS SOLUTIONS OF
TERTIARY BUTANOL AT 30°.
(Ginning and Robbins, 1930.)

The results which were determined by the synthetic method locate the binodal curve of the system and include tie lines * which show the composition of layers in contact with each other and the plait point, PP, at which the two liquid layers become homogeneous.

Gms. per 100 gms. sat. sol.		Gms. per 100 gms. sat. sol.		Gms. per 100 gms. sat. sol.	
$(CH_3)_3COH$	KCl	$(CH_3)_3COH$	KCl	$(CH_3)_3COH$	KCl
—	23.3*	18.2	8.1	39.0	4.2PP
7.9	15.9	20.5	7.4	43.8	3.3
9.4	14.6	—	7.1*	50.9	2.6
10.5	13.3	—	6.7*	53.0	—
11.5	12.2	23.9	6.2	57.0	—
12.5	11.4	28.3	5.6	58.4	2.0
16.5	9.0	33.3	4.8	67.3	1.4
		36.6	4.5	90.0	—

The composition of the plait point, PP, at 25° is 4.5 gms. KCl and 41.0 gms. $(CH_3)_3COH$ per 100 gms. sat. solution. Ginnings, Herring and Webb, 1933.

DISTRIBUTION OF POTASSIUM CHLORIDE BETWEEN WATER
AND BUTYL ALCOHOL AT 25°.

(Alleman, 1928.)

Normality of KCl in:		(b)	Normality of KCl in:		(b)
H ₂ O layer (a)	C ₄ H ₉ OH (b) layer	(a)	H ₂ O layer (a)	C ₄ H ₉ OH layer (b)	(a)
2.0	0.0182	0.0091	0.25	0.0051	0.0199
1.0	0.0134	0.0135	0.10	0.0020	0.0204
0.50	0.0079	0.0167	0.025	(0.0011)	(0.0455)

DISTRIBUTION OF POTASSIUM CHLORIDE AT 17° BETWEEN : (Wosnessensky, 1925.)

Water and Amyl Alcohol.

Water and Phenol.

Millimols. KCl per liter of		C ₁	Millimols. KCl per liter		C ₁
H ₂ O layer (C ₁).	Alcohol layer (C ₂).	C ₂ ¹⁰⁰	H ₂ O layer (C ₁).	Phenol layer (C ₂).	C ₂
360.255	0.831	461	64.0	4.5	14.2
512.011	1.050	480	111.5	7.9	14.1
677.507	1.287	486	290.3	20.4	14.2
810.000	1.491	478	324.5	22.8	14.2
921.140	1.648	477			

SOLUBILITY OF POTASSIUM CHLORIDE IN ANHYDROUS ACETIC ACID
DETERMINED BY THE SYNTHETIC METHOD.

(Davidson and Chappell, 1938.)

t°	Gm. Mols. KCl per 100 gm. mols. KCl + CH ₃ COOH	Solid Phase	t°	Gm. Mols. KCl per 100 gm. mols. KCl + CH ₃ COOH	Solid Phase
16.45	0.168	CH ₃ COOH	59	0.239	KCl
24	0.157	KCl	63	0.257	"
30	0.170	"	70	0.272	"
39	0.188	"	76	0.295	"
47	0.207	"	87	0.336	"
55	0.229	"	93	0.367	"

SOLUBILITY OF POTASSIUM CHLORIDE IN AQUEOUS
SOLUTIONS OF URETHAN AT 25°.

(Palitsch, 1929, 1929.)

Gm. Mols. per 1000 gms. H ₂ O		Solid Phase	Gm. Mols. per 1000 gms. H ₂ O		Solid Phase
NH ₂ COOC ₂ H ₅	KCl		NH ₂ COOC ₂ H ₅	KCl	
0.0	4.83	KCl	2.597	4.16	KCl + NH ₂ COOC ₂ H ₅
0.0561	4.81	"	3.972	3.84	Lower liquid layer
0.0786	4.80	"	27.556	2.20	Upper " "
0.2245	4.76	"	28.477	2.0	NH ₂ COOC ₂ H ₅
0.5612	4.66	"	40.88	1.0	"
1.1225	4.49	"	53.09	0.0	"

100cc sat. sol. of potassium chloride in ethyl urethan (NH₂COOC₂H₅)
contain 0.105 gm. KCl at 60°. (Stuckgold, 1917.)

SOLUBILITY OF POTASSIUM CHLORIDE IN AQUEOUS ACETONE SOLUTIONS.

(Snell, 1898; at 20°, Herz and Knoch, 1904.)

Wt. (see Note) Per cent Acetone in Solvent.	At 20°.		At 30°.		At 40°.		At 50°.	
	KCl per 100 cc. Solution.		Gms. per 100 Gms. Solution.		Gms. per 100 Gms. Solution.		Gms. per 100 Gms. Solution.	
	Millimols.	Gms.	Acetone.	KCl.	Acetone.	KCl.	Acetone.	KCl.
0	410.5	30.62	0	27.27	0	28.60	0	30
9.1	351.7	26.23	6.96	23.42	6.79	25.33	...	...
20	286.6	21.38	16.22	18.90	15.75	21.28	...	...
30	223.7	16.69	25.45	15.06	two layers		25.67	14.42
40	166.5	12.42	35.52	11.31	"		36.03	9.93
50	115.4	8.61	45.98	8.04	"		46.46	7.07
60	71.2	5.31	56.91	5.12	"		57.37	4.38
70	38.5	2.87	68.18	2.60	"		68.56	2.22
80	12.9	0.96	79.43	0.76	79.34	0.58	79.25	0.04
90	2	0.15	89.88	0.13	89.84	0.16	± 81° sat. sol.	
100	0	0	100	0	100	0		

NOTE. — For the 20° results the per cent acetone in the solvent is in terms of volume instead of weight per cent, and the concentration of the second solution is 10 per cent instead of 9.1 which is the weight per cent concentration of the solvent for the corresponding results at the other temperatures.

Cl

AT THE TEMPERATURE 40° AND FOR CONCENTRATIONS OF ACETONE BETWEEN 20 AND 80 PER CENT THE SATURATED SOLUTION SEPARATES INTO TWO LAYERS HAVING THE FOLLOWING COMPOSITIONS:

Upper Layer.			Lower Layer.		
Gms. per 100 Gms. Solution.			Gms. per 100 Gms. Solution.		
H ₂ O.	(CH ₃) ₂ CO.	KCl.	H ₂ O.	(CH ₃) ₂ CO.	KCl.
55.2	31.82	12.99	28.14	69.42	2.44
53.27	35.44	11.29	30.96	65.97	3.07
51.23	48.50	10.27	32.64	63.79	3.56
50.34	39.88	9.77	34.07	62.01	3.92
48.02	43.18	8.79	37.44	57.67	4.89
46.49	45.34	8.17	38.68	56.17	5.25
58.99	25.24	15.77	23.66	74.91	1.43

Note. — No solid phase could be present when equilibrium is attained since, with vapor, there are 3 components and 4 phases; hence if the temperature is fixed the system becomes invariant.

100 cc. sat. solution of potassium chloride in furfural (C₄H₃O.CO.H) contain 0.085 gm. KCl at 25°. (Walden, 1906.)

1000 gms. highly purified acetone dissolve 0.00087 gm. KCl at 18° and 0.00097 gm. at 37° as calculated from specific conductivity measurements. (Lannung, 1932.)

SOLUBILITY OF POTASSIUM CHLORIDE IN DILUTE AQUEOUS SOLUTIONS OF
SEVERAL COMPOUNDS AT 25°.

(Armstrong and Eyre, 1913.)

Compound.	Gms. Cmpd. per 1000 Gms. H ₂ O.	Gms. KCl per 100 Gms. Sat. Sol.	Compound.	Gms. Cmpd. per 1000 Gms. H ₂ O.	Gms. KCl per 100 Gms. Sat. Sol.
Water alone	...	26.89	Glycol	15.51	26.43
Acetaldehyde	11.01	27.05	"	62.05	25.26
Paraldehyde	11.01	26.42	Mannitol	45.53	24.86
Glycerol	13.01	25.58	"	136.59	24.46
100 gms. 95% formic acid dissolve 19.4 gms. KCl at 19.7°. (Aschan, 1913.)					
" glycerol ($d_{15} = 1.256$)	"	3.72	" " " 15-16°.	"	(Ossendowski, 1907.)
100 cc. anhydrous hydrazine	"	9	" " " room temp.	"	(Welsh and Broderson, 1915.)
100 gms. hydroxylamine	"	12.3	" " " 17-18°.	"	(de Bruyn, 1892.)

SOLUBILITY OF POTASSIUM CHLORIDE IN AQUEOUS SOLUTIONS OF GLYCOL AT 30°.

(Trimble, 1931.)

d. of sat. sol.	Gms. per 100 gms. sat. sol.	
	CH ₂ OHCH ₂ OH	KCl
1.1820	0.0	27.10
1.1648	15.08	21.97
1.1510	33.47	16.53
1.1424	52.00	11.84
1.1371	73.27	7.75
1.1368	94.90	5.00

SOLUBILITY OF POTASSIUM CHLORIDE IN AQUEOUS SOLUTIONS OF GLYCEROL AT 25°.

(Herz and Knoch, 1905.)

Sp. Gr. of Glycerol at 25°/4° = 1.2555.

Impurity about 1.5%.

Wt. Per cent Glycerol in Solvent.	KCl per 100 cc. Solution.		Sp. Gr. of Solutions.	Wt. Per cent Glycerol in Solvent.	KCl per 100 cc. Solution.		Sp. Gr. of Solutions.
	Millimols.	Gms.			Millimols.	Gms.	
0	424.5	31.66	1.180	54.23	238.5	17.79	1.219
13.28	383.4	28.61	1.185	83.84	149	11.11	1.259
25.98	339.3	25.31	1.194	100	110.6	8.25	1.286
45.36	271.4	20.24	1.211				

100 gms. H₂O dissolve 246.5 gms. sugar + 44.8 gms. KCl at 31.25°, or 100 gms. of the sat. solution contain 62.28 gms. sugar + 11.33 gms. KCl. (Köhler, 1897.)

SOLUBILITY OF POTASSIUM CHLORIDE IN AQUEOUS SOLUTIONS OF GLUCOSE AT 25°.

(Armstrong and Eyre, 1910-11.)

Wt. % C ₆ H ₁₂ O ₆ + H ₂ O in Aq. Solvent.	Gms. KCl per 100 Gms. Sat. Solution.
0	26.63
4.72	25.86
9	25.18
16.53	23.89
37.27	20.15

SOLUBILITY OF POTASSIUM CHLORIDE IN AQUEOUS SOLUTIONS OF DIOXAN AT 25°.
(Herz and Lorents, 1929.)

Vol. Percent Dioxan in Solvent	Gms. Mol. KCl per liter sat. sol.	Vol. Percent Dioxan in Solvent	Gms. Mol. KCl per liter sat. sol.
10	3.45	55	0.85 (L)
20	2.80	77	0.14 (U)
33	2.00	80	0.12
50	1.22		

Between 51 and 77 Vol. percent Dioxan to liquid layers are formed
(L) = lower liquid layer (U) = upper liquid layer

SOLUBILITY OF POTASSIUM CHLORIDE IN AQUEOUS SOLUTIONS OF PYRIDINE AT 10°.
(Schroeder, 1908.)

Aq. Mixture.		Gms. KCl per 100 Gms. Sat. Sol.	Aq. Mixture.		Gms. KCl per 100 Gms. Sat. Sol.
cc. H ₂ O.	cc. Pyridine.		cc. H ₂ O.	cc. Pyridine.	
100	0	23.79	40	60	3.33
90	10	19.76	30	70	1.25
80	20	16.37	20	80	0.24
70	30	13.19	10	90	0.04
60	40	10.05	0	100	0
50	50	6.34			

Cl

The binodal curve and plait point of the system KCl + Pyridine + H₂O at 25° has been determined by Ginnings, Webb and Hinohara, 1933, but the authors do not give their experimental results but only the values of a series of arbitrary constants calculated from them by means of empirical equations.

100 gms. liquid Sulfur Dioxide dissolve 0.041 gm. KCl at 0°. (Jander and Ruppolt, 1937.)

100 gms. sat. sol. of Potassium Chloride in Selenium Oxychloride (SeOCl₂) contain 2.89 gms. KCl at 25°. (Wise, 1923.)

FUSION-POINT DATA HAVE BEEN DETERMINED FOR THE
FOLLOWING MIXTURES OF KCl AND OTHER SALTS.

KCl + KI (1)(2)(3)	KCl + K ₂ SO ₄ (3)(5)(7)	KCl + NaCl (3)(8)(11)(12)
" + KF (3)	" + LiCl (18)(21)(22)	" + NaI (24)
" + KOH (4)	" + " + NaCl (18)	" + Na ₂ SO ₄ (8)
" + KCrO ₄ (5)(25)	" + MgCl ₂ (16)(17)	" + RbCl (19)
" + KPO ₃ (6)	" + HgCl ₂ (8)	" + SbCl ₃ (20)(23)
" + K ₃ P ₂ O ₇ (6)	" + NH ₄ Cl (15)	" + SrCl ₂ (9)(5)(13)
" + K ₄ P ₂ O ₇ (16)	" + NH ₄ NO ₃ (14)	" + " + NaCl (13)
		" + TiCl ₃ (10)

(1) Wrzesnewski, 1912; (2) Amadori and Pampanini, 1911; (3) Ruff and Plato, 1903; (4) Scarpa, 1915; (5) Sackur, 1911-12; (6) Amadori, 1912; (7) Janecke, 1912; (8) Sackur, 1913; (9) Vortisch, 1914; (10) Sandonnini, 1911; 1914; (11) Schaeffer, 1919; (12) Lautsberry and Page, 1920; (13) Scholich, 1920; (14) Perman and Saunders, 1923; (15) Janecke, 1928; (16) Menge, 1911; (17) Derbny, 1918; (18) Richards and Meldrum, 1917; (19) Keitel, 1925; (20) Kendall, Crittenden and Miller, 1923; (21) Elchardus and Laffitte, 1932; (22) Keitel, 1925; (23) Zouravlev, 1939 (24) Waxberg, 1930; (25) Zemcznzy, 1908.

POTASSIUM Palladium CHLORIDE K_2PdCl_6

From measurements of the solubility of Potassium Chloro-palladate (K_2PdCl_6) at 25° in normal aqueous Hydrochloric Acid containing KCl and saturated with Chlorine at atmospheric pressure the Solubility Product (K^+)²($PdCl_6^{--}$) was found to be 5.97×10^{-6} moles per liter. (Wellman, 1930.)

POTASSIUM Platinum CHLORIDE See **PLATINUM CHLORIDES****POTASSIUM Rhenium CHLORIDE** K_2ReCl_6 **POTASSIUM Rhenium Oxy CHLORIDE** $K_4Re_2OCl_{10}$ **SOLUBILITY OF EACH SEPARATELY IN AQUEOUS HYDROCHLORIC ACID.**

(Noddak and Noddak, 1937.)

Wt. Percent HCl in Aq. Solvent	Gms. K_2ReCl_6 per 1000cc sat. solution at:		Gms. $K_4Re_2OCl_{10}$ per 1000cc sat. solution at:	
	0°	18°	0°	18°
12.0	21.38	30.28	75.0	—
20.0	25.0	46.0	—	—
37.0	3.3	3.72	5.5	—

Mono POTASSIUM Tin CHLORIDE $KSnCl_3 \cdot H_2O$.**SOLUBILITY OF MONO POTASSIUM STANNO CHLORIDE IN WATER.**

(Rimbach and Fleck, 1916.)

t°	3°.2	14°.2	37°.5	59°.4	71°.0
Gms. $KSnCl_3$ per 100 gms. sat. sol....	26.1	34.9	54.0	72.8	82.1

Solid phase $KSnCl_3 \cdot H_2O$ at all temperatures.**Di POTASSIUM Tin CHLORIDE** $K_2SnCl_4 \cdot 2H_2O$.**SOLUBILITY OF DI POTASSIUM STANNO CHLORIDE IN WATER.**

(Rimbach and Fleck, 1916.)

t°	Gms. per 100 gms. sat. sol.				Solid Phase.
	Cl.	Sn.	K.	K_2SnCl_4 .	
2.3*..	9.14	3.28	7.94	—	$K_2SnCl_4 \cdot ?H_2O$
14.1*..	12.18	5.68	9.72	—	"
35.6...	18.28 +	14.56 +	10.61 =	43.5	$K_2SnCl_4 \cdot 2H_2O$
57.4...	23.13 +	19.50 +	12.72 =	55.4	"
77.3...	26.56 +	22.35 +	14.63 =	63.5	"

Tetra POTASSIUM Tin CHLORIDE $K_4SnCl_6 \cdot H_2O$.**SOLUBILITY OF TETRA POTASSIUM STANNO CHLORIDE IN WATER.**

(Rimbach and Fleck, 1916.)

t°	Gms. per 100 gms. sat. sol.				Solid Phase.
	Cl.	Sn.	K.	K_4SnCl_6 .	
0.5*..	10.99	0.93	11.55	—	$K_4SnCl_6 \cdot H_2O + SnCl_2 \cdot H_2O$
19.5*..	13.10	1.93	13.19	—	" "
41.0*..	16.00	5.82	13.84	—	" "
61.7*..	20.18	9.95	15.73	—	" "
70.0...	22.71 +	12.86 +	16.63 =	52.20	$K_4SnCl_6 \cdot H_2O$
81.2...	25.74 +	19.57 +	15.71 =	61.02	"

* At these temperatures the atomic ratios in solution did not correspond to the double salt hence the solid phase is a mixture of the double salt and stannic chloride.

Experiments on the Solubility of Potassium Stannic Chloride and Ammonium Stannic Chloride in Aqueous Solutions of Hydrochloric Acid containing sodium and ammonium chlorides are given by Smith, 1928.

SOLUBILITY OF POTASSIUM CHLORATE IN WATER.

The results of Taylor, 1897; Carlson, 1910; Galzolari, 1912; Brönsted, 1913; Tschugneff and Chlopin, 1914; Toda, 1921, 1922; Iljinski, 1922; Wright, 1927; DiCapua and Scalletti, 1927; Flöttmann, 1928; Ricci, 1937, 1938; and Ricci and Yanik, 1937, were plotted and the following average values read from the curve. The results above 100° are from Tilden and Shenstone, 1881; and Benrath, Gjedebo, Schiffera and Wunderlich, 1937. The solid phase is KClO_3 in all cases.

t°	d. of sat. sol.	Gms. KClO_3 per 100 gms. sat. sol.	t°	d. of sat. sol.	Gms. KClO_3 per 100 gms. sat. sol.	t°	Gms. KClO_3 per 100 gms. sat. sol.
0	1.021	3.2	70	—	23.2	200	72.0
10	—	4.9	80	1.165	27.3	230	78.0
15	(1.0363)	5.7 (5.739)	90	—	31.5	240	83.0
20	(1.0420)	6.8 (6.793)	100	1.219	36.0	260	87.0
25	(1.0484)	7.9 (7.999)	104b. p.	1.230	37.5	280	91.0
30	—	9.2	120	—	43.5	300	94.5
40	1.073	12.2	140	—	52.0	330	96.7
50	—	15.6	160	—	59.0		
60	1.115	19.2	180	—	64.5		

The results in parentheses are by Flöttmann, 1928.

ClO SOLUBILITY OF POTASSIUM CHLORATE IN AQUEOUS SOLUTIONS OF POTASSIUM CHLORIDE AT 20°.

(Winteler — Z. Electrochem. 7, 360, '00.)

Sp. Gr. of Solutions.	Grams per Liter.		Sp. Gr. of Solutions.	Grams per Liter.	
	KCl.	KClO_3 .		KCl.	KClO_3 .
I.050	0	71.1	I.098	120	24.5
I.050	10	58.0	I.108	140	22.5
I.050	20	49.0	I.119	160	21.0
I.054	40	39.5	I.130	180	20.0
I.064	60	34.0	I.140	200	20.0
I.075	80	30.0	I.168	250	20.0
I.086	100	27.0			

SOLUBILITY OF POTASSIUM CHLORATE IN AQUEOUS SOLUTIONS OF POTASSIUM NITRATE.

(Arrhenius — Z. physik. Chem. 12, 397, '95.)

Results at 19.85°.

Results at 23.87°.

Mols. per Liter.		Grams per Liter.		Mols. per Liter.		Grams per Liter.	
KNO_3 .	KClO_3 .	KNO_3 .	KClO_3 .	KNO_3 .	KClO_3 .	KNO_3 .	KClO_3 .
0.0	0.570	0.0	69.88	0.0	0.645	0.0	79.09
0.125	0.529	12.65	64.86	0.5	0.515	50.59	63.14
0.25	0.492	25.29	60.33				
1.0	0.374	101.19	45.85				
2.0	0.328	202.38	40.22				

APPROXIMATE SOLUBILITY OF POTASSIUM CHLORATE IN AQUEOUS SALT SOLUTIONS
AT SEVERAL TEMPERATURES. (Aleksceevsky, 1921.)

The determinations were made by adding KClO_3 to the aqueous solvent until no more dissolved after a period of 3 hours. The curves drawn from the results are very irregular, thus showing that saturation could not have been reached in all cases.

t°.	Gms. KClO_3 per 100 cc sat. Solution in Aqueous.					
	5 % K_2CO_3 .	10 % K_2CO_3 .	20 % K_2CO_3 .	30 % K_2CO_3 .	40 % K_2CO_3 .	50 % K_2CO_3 .
20.....	6.0	5.0	4.0	2.5	2.0	1.0
30.....	6.5	6.0	5.0	3.5	2.5	2.5
40.....	8.5	8.0	6.5	4.5	4.5	3.5
50.....	9.5	9.0	7.5	6.0	6.0	4.0

t°.	Gms. KClO_3 per 100 cc sat. Solution in Aqueous.		
	5 to 7 % Na_2CO_3 .	5 % NaCl .	30 % NaCl .
20.....	5.0	5.0	5.0
30.....	5.5	5.5	5.5
40.....	7.5	7.5	6.5
50.....	10.5	13.0	11.5

SOLUBILITY OF POTASSIUM CHLORATE IN AQUEOUS SOLUTIONS OF
POTASSIUM HYDROXIDE AT 20°. (Brønsted, 1920 a.)

Gm. mols. per liter.		Gm. mols. per liter.		Gm. mols. per liter.	
KOH.	KClO_3 .	KOH.	KClO_3 .	KOH.	KClO_3 .
4.71	0.0924	8.60	0.0410	14.02	0.0215
5.06	0.0882	9.41	0.0351	14.85	0.0195
6.35	0.0609	10.95	0.0287	15.02	0.0191
7.95	0.0445	12.19	0.0254		

SOLUBILITY OF POTASSIUM CHLORATE IN AQUEOUS SOLUTIONS OF POTASSIUM NITRATE
AND VICE VERSA AT 25°. (Toda, 1921 a, 1922.)

Saturation was secured by constant rotation in a thermostat.

Gms. per 100 gms. sat. sol.		Solid Phase.	Gms. per 100 gms. sat. sol.		Solid Phase.
KNO_3 .	KClO_3 .		KNO_3 .	KClO_3 .	
0.0	7.745	KClO_3	18.97	4.39	$\text{KClO}_3 \cdot \text{NO}_3$
0.68	7.65	$\text{KClO}_3 \cdot \text{NO}_3$	27.14	3.90	"
1.55	7.07	"	27.14	3.90	$\text{KClO}_3 + \text{KNO}_3$
3.59	6.52	"	27.21	3.61	KNO_3
7.12	5.76	"	27.57	1.63	"
12.81	5.10	"	27.24	0.0	"

SOLUBILITY OF POTASSIUM CHLORATE IN AQUEOUS SOLUTIONS OF SODIUM CHLORATE
AND VICE VERSA AT 24° 2. AND AT 40°. (Iljinsky, 1924.)

See note under Potassium carbonate.

t°.	d of sat. sol.	Gms. per 100 gms. H_2O .		Solid Phase.	t°.	d of sat. sol.	Gms. per 100 gms. H_2O .		Solid Phase.
		NaClO_3 .	KClO_3 .				NaClO_3 .	KClO_3 .	
24.2..	1.045	0.5	8.1	KClO_3	24.2..	1.441	99.7	3.1	$\text{KClO}_3 + \text{NaClO}_3$
" ..	1.086	7.5	8.0	"	" ..	1.429	98.6	0.0	NaClO_3
" ..	1.189	27.5	7.0	"	40....	1.073	0.0	14.2	KClO_3
" ..	1.241	41.0	6.0	"	" ..	-	13.5	9.9	"
" ..	1.260	47.4	5.0	"	" ..	1.268	48.4	7.0	"
" ..	1.326	60.0	5.2	"	" ..	1.308	58.7	7.0	"
" ..	1.329	61.8	5.6	"	" ..	1.453	98.8	7.0	"
" ..	1.392	82.7	5.3	"	" ..	1.483	116.0	7.2	" + NaClO_3
					" ..	1.462	116.4	0.0	NaClO_3

SOLUBILITY OF POTASSIUM CHLORATE IN AQUEOUS SOLUTIONS OF POTASSIUM HYDROXIDE, HYDROGEN PEROXIDE, AND MIXTURES OF THE TWO AT 25°.

(Calvert, 1901.)

The mixtures were agitated by means of a stream of air. Equilibrium was approached both from above and below 25°.

Composition of Solvent.				Mols. KClO_3 Dissolved per Liter of Sat. Sol.	Gms. KClO_3 Dissolved per Liter of Sat. Sol.
Water alone				0.675	82.71
Aqueous 0.125 N KOH				0.625	76.60
" 0.25 " "				0.573	70.23
Aq. H_2O_2 containing 1.26 mols. H_2O_2 per l.				0.730	89.45
" " " " 1.31 " "				0.737	90.33
Aq. 0.25 N KOH " 0.015 " "				0.578	70.82
" " " " 0.276 " "				0.584	71.57
" " " " 0.954 " "				0.616	75.50
" " " " 1.073 " "				0.673	82.47

SOLUBILITY OF POTASSIUM CHLORATE IN AQUEOUS SOLUTIONS OF POTASSIUM BROMIDE AT 13°. (Blarez, 1911.)

Gms. per 100 Gms. Solution.		Gms. per 100 Gms. Solution.		Gms. per 100 Gms. Solution.	
KBr.	KClO_3 .	KBr.	KClO_3 .	KBr.	KClO_3 .
0.20	5.18	1.0	5.04	6.0	3.46
0.60	5.20	2.0	4.60	8.0	2.80
0.8	5.06	3.0	4.2	10.0	2.40
		4.0	4.0		

SOLUBILITY OF POTASSIUM CHLORATE IN AQUEOUS SOLUTIONS OF OTHER POTASSIUM SALTS AT 14°-15°. (Blarez, 1911.)

Salt.	Gms. per 100 Gms. Solution.		Salt.	Gms. per 100 Gms. Solution.	
	K Salt.	KClO_3 .		K Salt.	KClO_3 .
KOH	1.43	4.47	KNO_3	2.59	4.51
KCl	1.91	4.45	"	5.18	3.88
"	3.82	3.58	K_2SO_4	2.23	4.71
KBr	3.05	4.49	"	4.46	3.98
"	6.10	3.60	$\text{K}_2\text{C}_2\text{O}_4$	2.42	4.72
KI	4.25	4.59	"	4.85	3.93
"	8.51	3.65			

SOLUBILITY OF POTASSIUM CHLORATE IN AQUEOUS SOLUTIONS OF SEVERAL SALTS, EACH DETERMINED SEPARATELY AT 25°.

(Holluta and Peter, 1929.)

Concentration of Aq. Solvent in Gm. Equiv. Salt per liter	Gms. KClO_3 per liter sat. solution in Aq. Solutions of:				
	KCl	KNO_3	K_2SO_4	NaClO_3	NaCl
0.0	83.030	83.030	83.030	83.030	83.030
0.025	—	—	82.570	—	—
0.05	—	—	80.622	—	—
0.1	76.653	77.951	79.103	76.974	83.233
0.2	71.484	75.225	75.387	71.959	84.383
0.3	67.793	72.587	71.995	67.655	85.615
0.4	64.191	70.346	69.834	63.805	85.998
0.5	60.375	68.695	67.004	60.027	86.968
0.75	54.010	63.619	59.369	53.208	88.069
1.0	48.142	61.096	54.310	49.170	88.924
2.0	34.673	53.213	—	40.425	90.398
3.0	27.600	49.068	—	32.340	—
4.0	—	—	—	22.228	—
5.0	—	—	—	11.385	—

SOLUBILITY OF POTASSIUM CHLORATE IN AQUEOUS SOLUTIONS OF
POTASSIUM IODIDE AT 25° AND VICE VERSA.

(Ricci, 1937.)

d. of sat. sol.	Gms. per 100 KClO ₃	gms. sat. sol. KI	Solid Phase	d. of sat. sol.	Gms. per 100 KClO ₃	gms. sat. sol. KI	Solid Phase
1.047	7.905	0.0	KClO ₃	1.555	1.10	49.94	KClO ₃
1.103	5.04	9.33	"	1.702	0.82	58.34	"
1.178	3.35	18.74	"	1.724	0.83	59.28	" + KI
1.275	2.30	28.72	"	1.724	0.67	59.36	KI
1.400	1.60	39.26	"	1.718	0.0	59.76	"

SOLUBILITY OF POTASSIUM CHLORATE IN AQUEOUS SOLUTIONS OF
POTASSIUM IODATE AND VICE VERSA.

(Ricci, 1938.)

Results at 25°

Results at 50°

d. of sat. sol.	Gms. per 100 KIO ₃	gms. sat. sol. KClO ₃	Solid Phase
1.048	0.0	7.90	KClO ₃
1.068	2.92	7.31	"
1.090	5.43	6.80	" + KIO ₃
1.082	5.85	5.31	KIO ₃
1.070	7.05	2.31	"
1.043	8.45	0.0	"

d. of sat. sol.	Gms. per 100 KIO ₃	gms. sat. sol. KClO ₃	Solid Phase
	0.0	15.78	KClO ₃
	2.41	15.11	"
	5.27	14.31	"
	7.27	13.77	" + KIO ₃
	8.76	8.58	KIO ₃
	10.87	3.71	"
	13.21	0.0	"

SOLUBILITY OF POTASSIUM CHLORATE IN AQUEOUS SOLUTIONS OF
POTASSIUM SULFATE AND VICE VERSA.

(Ricci and Yanick, 1937.)

d. of sat. sol.	Gms. per 100 KClO ₃	gms. sat. sol. K ₂ SO ₄	Solid Phase
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d. of sat. sol.	Gms. per 100 KClO ₃	gms. sat. sol. K ₂ SO ₄	Solid Phase
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Results at 15°

Results at 25° (con.)

1.032	5.676	0.0	KClO ₃
1.085	3.29	7.86	" + K ₂ SO ₄
1.076	0.0	9.258	K ₂ SO ₄

1.100	4.96	8.64	KClO ₃ + K ₂ SO ₄
1.099	3.30	9.43	K ₂ SO ₄
1.089	1.80	9.93	"
1.083	0.0	10.76	"

Results at 25°

Results at 45°

1.048	7.897	0.0	KClO ₃
1.063	6.72	2.73	"
1.080	5.77	5.57	"
1.099	5.06	8.19	"

—	13.90	0.0	KClO ₃
—	9.80	9.13	" + K ₂ SO ₄
—	0.0	13.53	K ₂ SO ₄

1000cc aqueous 5.2 percent NH₃ Solution dissolve 52.5 gms. KClO₃
at 20°. (Konowalow, 1899b)

SOLUBILITY OF POTASSIUM CHLORATE IN AQUEOUS SOLUTIONS OF
SODIUM CHLORATE AND VICE VERSA AT 20°.
(Dicapua and Scallott, 1927.)

The quite irregular results of the authors were plotted and the following average values taken from the curve.

Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase
KClO ₃	NaClO ₃		KClO ₃	NaClO ₃	
6.75	0.0	KClO ₃	2.5	40.0	KClO ₃
4.6	5.0	"	2.5	42.0	" + NaClO ₃
3.8	10.0	"	2.0	42.5	NaClO ₃
3.4	15.0	"	1.0	45.0	"
3.1	20.0	"	0.33	47.5	"
2.7	30.0	"	0.0	49.5	"

SOLUBILITY OF POTASSIUM CHLORATE:
(Taylor, 1897; see also Gerardin, 1861.)

In Aqueous Alcohol.

In Aqueous Acetone.

Wt. percent Alcohol or of Acetone in Solvent.	At 30°.		At 40°		At 30°.		At 40°.	
	Gms. KClO ₃ per 100 Gms.		Gms. KClO ₃ per 100 Gms.		Gms. KClO ₃ per 100 Gms.		Gms. KClO ₃ per 100 Gms.	
	Solution.	Water.	Solution.	Water.	Solution.	Water.	Solution.	Water.
0	9.23	10.17	12.23	13.93	9.23	10.17	12.23	13.93
5	7.72	8.80	10.48	12.33	8.32	9.56	11.10	13.11
10	6.44	7.65	8.84	10.77	7.63*	9.09	10.28*	12.60
20	4.51	5.90	6.40	8.56	6.09	8.10	8.27	11.26
30	3.21	4.74	4.67	7.00	4.93	7.40	6.69	10.24
40	2.35	4.00	3.41	5.88	3.90	6.76	5.36	9.45
50	1.64	3.33	2.41	4.94	2.90	5.98	4.03	8.40
60	1.01	2.53	1.41	3.69	2.03	5.17	2.86	7.35
70	0.54	1.82	0.78	2.63	1.24	4.18	1.68	5.68
80	0.24	1.22	0.34	1.73	0.57	2.88	0.79	3.97
90	0.06	0.62	0.12	1.17	0.18	1.82	0.24	2.45

* Solvent, 999 Wt. per cent Acetone.

100 gms. aqueous 50.0 wt. percent C₂H₅OH solution dissolve 1.1 gms. KClO₃ at 20° and 14.1 gms. at 100°. The determinations were made in sealed tubes. (Wright, 1927.)

SOLUBILITY OF POTASSIUM CHLORATE IN AQUEOUS
SOLUTIONS OF ACETONE AT 17.6°.
(Hartley, 1931.)

The saturated solutions were prepared in sealed glass tubes and analyzed by evaporation to dryness and weighing.

Mol. (CH ₃) ₂ CO per 1.0 mol. (CH ₃) ₂ CO + H ₂ O	Mol. KClO ₃ per 1.0 mol. KClO ₃ + (CH ₃) ₂ CO + H ₂ O
0.000	0.00951
0.0233	0.00847
0.0409	0.00779
0.0513	0.00740

SOLUBILITY OF POTASSIUM CHLORATE IN AQUEOUS SOLUTIONS OF VARIOUS COMPOUNDS AT 25°. (Rothmund, 1910.)

Aqueous 0.5 Normal Solution of:	KClO ₃ per Liter.		Aqueous 0.5 Normal Solution of:	KClO ₃ per Liter.	
	Mols.	Gms.		Mols.	Gms.
Water alone	0.1475	20.44	Ammonia	0.1474	20.43
Methyl Alcohol	0.1402	19.43	Dimethylamine	0.1342	18.60
Ethyl Alcohol	0.1356	18.75	Pyridine	0.1410	19.54
Propyl Alcohol	0.1343	18.61	Urethan	0.1400	19.40
Tertiary Amyl Alcohol	0.1279	17.72	Formamide	0.1539	21.32
Acetone	0.1451	20.11	Acetamide	0.1447	20.05
Ether	0.1336	18.51	Acetic Acid	0.1462	20.26
Glycol	0.1416	19.62	Phenol	0.1362	18.87
Glycerol	0.1404	19.45	Methylal	0.1400	19.40
Urea	0.1510	20.92	Methyl Acetate	0.1429	19.80

SOLUBILITY OF POTASSIUM CHLORATE IN GLYCEROL.

t°	d. of Glycerol	Percent Glycerol	Gms. KClO ₃ per 100 gms. glycerol	Authority
15-16	1.256	96.0	3.54	(Ossendowski, 1907.)
20	1.2326	86.5	1.32	(Holm, 1921, 1921(a), 1922.)
20	1.2645	98.5	1.03	" " " "
25	1.249	95.0	1.05	(Schnellbach and Rosin, 1931.)

100 gms. sat. solution of KClO₃ in glycol contain 0.9 gm. KClO₃.
(de Coninck, 1905.)

100 gms. liquid ammonia (NH₃) dissolve 2.52 gms. KClO₃ at 0°.
(Hunt and Boncyk, 1933.)

POTASSIUM PER CHLORATE KClO₄

SOLUBILITY OF POTASSIUM PERCHLORATE IN WATER.

The following values were taken from an average curve constructed from the results of Pierrot, 1921; Willard and Smith, 1923; Moser and Ritschel, 1925; Flöttmann, 1928; Cornec and Neumeister, 1929; Flatt and Jordan, 1930, 1933; and Caven and Bryce, 1934. Above 100° Benrath Gjedebø, Schiffers and Wunderlich, 1937. The results in parentheses are the average of previously reported determinations by Carlson, 1910; Rosenheim and Weinhaber, 1910-11 and Calzolari, 1912. The solid phase is KClO₄ in all cases.

t°	d. of sat. sol.	Gms. KClO ₄ per 100 gms. sat. sol.	t°	d. of sat. sol.	Gms. KClO ₄ per 100 gms. sat. sol.	t°	Gms. KClO ₄ per 100 gms. sat. sol.
0	1.005	0.75	50	1.017	4.90 (6.5)	120	25
10	—	1.05	60	(1.033)	6.8 (9.0)	140	32.5
15	1.0076	1.33	70	—	9.2 (11.8)	180	46
20	1.0085	1.65	75	1.036	10.36	200	52.5
25	1.0096	2.03	80	(1.053)	11.8 (14.8)	225	60
30	—	2.50	90	—	15.0 (18.0)	250	67
40	(1.022)	3.60 (4.4)	100	1.068	18.2 (21.8)	265	70

SOLUBILITY OF POTASSIUM PERCHLORATE IN AQUEOUS
SOLUTIONS OF HYDROGEN PEROXIDE AT 25°
(Akerlof and Turck, 1935.)

Gms. H_2O_2 per 100 gms. aq. solvent	Gm. Mols. $KClO_4$ per 1000 gms. aq. solvent
0.00	0.149
15.72	0.175
31.43	0.199

SOLUBILITY OF POTASSIUM PERCHLORATE IN AQUEOUS
SOLUTIONS OF ALUMINUM PERCHLORATE AT 30°.
(Craven and Bryce, 1934.)

Gms. per 100 gms. H_2O		Solid Phase	Gms. per 100 gms. H_2O		Solid Phase
$Al(ClO_4)_3$	$KClO_4$		$Al(ClO_4)_3$	$KClO_4$	
0.0	2.528	$KClO_4$	4.956	1.028	$KClO_4$
2.652	1.462	"	8.158	0.7041	"
3.043	1.357	"	34.56	0.2115	"

SOLUBILITY OF POTASSIUM PERCHLORATE IN AQ. KCl AND Aq. K_2SO_4
SOLUTIONS AT 25°. (Noyes and Boggs, 1911.)

In Aq. KCl Solutions.

Gms. per 100.2 cc. Sat. Sol.		Wt. of 100.2 cc. of Solution.
$KClO_4$	KCl	
2.0566	0	...
1.7800	0.3715	101.42
1.5597	0.7421	101.45

In Aq. K_2SO_4 Solutions.

Gms. per 100.2 cc. Sat. Sol.		Wt. of 100.2 cc. of Solution.
$KClO_4$	K_2SO_4	
2.0566	0	...
1.8262	0.4330	101.47
1.6306	0.8665	101.55

SOLUBILITY OF POTASSIUM PERCHLORATE IN AQUEOUS SALT SOLUTIONS AT 25°.
(Bozorth, 1923.)

Saturation was obtained by constant agitation, and approaching equilibrium from above and from below. The salt content of the solvents was determined by evaporation and drying the residue at 200°. The salt content of the saturated solutions was determined in the same manner and the difference ascribed to dissolved perchlorate.

Salt.	Gm. Equiv. Salt. per 1000 gms. H_2O .	Gm. Equiv. $KClO_4$ per 1000 gms. H_2O .	Salt.	Gm. Equiv. Salt. per 1000 gms. H_2O .	Gm. Equiv. $KClO_4$ per 1000 gms. H_2O .
None = H_2O ..	0.0	0.1491 (=20.67 gms.)	$NaNO_3$...	0.1008	0.1611
KCl.....	0.0983	0.1136	"...	0.3139	0.1790
".....	0.2994	0.0757	".....	0.6220	0.1994
".....	0.6089	0.0535	K_2SO_4	0.0998	0.1194
KNO_3	0.0971	0.1174	".....	0.3025	0.0857
".....	0.2954	0.0846	".....	0.6008	0.0644
".....	0.6686	0.0642	Na_2SO_4 ...	0.1047	0.1633
$NaClO_4$	0.1026	0.1122	".....	0.3210	0.1800
".....	0.3090	0.0752	".....	0.6610	0.1957
".....	0.6273	0.0533	$BaCl_2$	0.0991	0.1569
$NaCl$	0.1007	0.1567	".....	0.2974	0.1638
".....	0.2994	0.1558	".....	0.5995	0.1693
".....	0.5903	0.1732	$Ba(NO_3)_2$.	0.0990	0.1605
			".....	0.3019	0.1747
			".....	0.6075	0.1902

SOLUBILITY OF MIXED CRYSTALS OF POTASSIUM PERMANGANATE AND
POTASSIUM PERCHLORATE AT 7°.

(Muthmann and Kuntze, 1894; recalculated by Fock, 1897.)

Milligram Mols. per Liter.		Gms. per Liter.		Mol. per cent KMnO ₄ in Crystals of Solid Phase.
KMnO ₄ .	KClO ₄ .	KMnO ₄ .	KClO ₄ .	
0	63.91	0	8.86	0
29.37	54.48	4.65	7.55	2.84
67.73	42.75	10.71	5.93	9.78
79.04	39.59	12.50	5.49	10.81
99.81	38.63	15.79	5.36	15.96
122.24	34.39	19.34	4.77	23.56
119.21	38.91	18.84	5.39	24.28
128.08	33.77	20.26	4.68	26.40
144.46	33.14	22.86	4.59	34.32
167.81	29.53	26.55	4.09	44.42
183.09	25.19	28.97	3.49	67.33
197.82	20.16	31.30	2.80	77.95
233.75	28.26	36.98	3.92	94.37
264.27	0	41.81	0	100

EQUILIBRIUM IN THE SYSTEM COMPOSED OF POTASSIUM AND
SODIUM PERCHLORATES AND NITRATES AT 25° AND AT 100°.
(Hering, 1926.)

t°	d. of sat. sol.	Gms. per 100 gms. H ₂ O				Solid Phase
		KClO ₄	NaClO ₄	NaNO ₃	KNO ₃	
25	1.013	2.07	—	—	—	KClO ₄
"	1.684	—	211.0	—	—	NaClO ₄ · H ₂ O
"	1.392	—	—	91.7	—	NaNO ₃
"	1.189	—	—	—	38.3	KNO ₃
"	1.684	0.87	210.0	—	—	KClO ₄ + NaClO ₄ · H ₂ O
"	1.732	—	209.0	41.7	—	NaClO ₄ + NaNO ₃
"	1.512	—	—	97.7	49.2	KNO ₃ + NaNO ₃
"	1.195	0.96	—	—	38.8	KClO ₄ + KNO ₃
"	1.733	1.91	208.0	41.2	—	" + NaNO ₃ + NaClO ₄ · H ₂ O
"	1.419	7.24	—	94.4	—	" + NaNO ₃
"	1.515	1.92	—	97.7	49.1	" + " + KNO ₃
100	1.070	22.1	—	—	—	"
"	1.758	—	329.0	—	—	NaClO ₄
"	1.507	—	—	175.1	—	NaNO ₃
"	1.569	—	—	—	244.0	KNO ₃
"	1.770	9.0	333.0	—	—	KClO ₄ + NaClO ₄
"	1.825	—	333.0	114.0	—	NaClO ₄ + NaNO ₃
"	1.786	—	—	234.0	328.0	KNO ₃ + NaNO ₃
"	1.609	22.0	—	—	255.0	KClO ₄ + KNO ₃
"	1.837	11.6	331.0	116.0	—	" + NaNO ₃ + NaClO ₄
"	1.578	38.6	—	186.0	—	" + " + "
"	1.803	22.6	—	242.0	332.0	" + " + KNO ₃

SOLUBILITY OF POTASSIUM PERCHLORATE IN AQUEOUS SOLUTIONS
OF SODIUM NITRATE AND VICE VERSA.

(Corneé and Neumeister, 1929.)

d. of sat. sol.	Gms. per 100 gms. sat. sol.		Solid Phase	d. of sat. sol.	Gms. per 100 gms. sat. sol.		Solid Phase
	KClO ₄	NaNO ₃			KClO ₄	NaNO ₃	

Results at 0°

1.005	0.75	0.0	KClO ₄
1.136	1.43	16.4	"
1.237	1.70	28.1	"
1.317	1.82	36.8	"
1.368	1.88	41.8	" + NaNO ₃
1.352	0.0	42.3	NaNO ₃

Results at 25°

1.013	2.03	0.0	KClO ₄
1.155	2.25	24.0	"
1.265	3.52	48.3	"
1.352	3.60	40.4	"
1.419	3.59	46.8	" + NaNO ₃
1.404	1.82	47.3	NaNO ₃
1.392	0.0	47.8	"

Results at 50° (con.)

1.441	1.85	52.6	NaNO ₃
1.427	0.0	53.2	"

Results at 75°

1.036	10.36	0.0	KClO ₄
1.187	10.81	19.8	"
1.312	10.28	34.0	"
1.407	9.61	43.5	"
1.461	9.11	48.9	"
1.521	8.61	54.4	" + NaNO ₃
1.509	6.11	55.7	NaNO ₃
1.501	5.92	56.0	"
1.492	3.92	56.7	"
1.488	3.20	57.1	"
1.486	2.80	57.3	"
1.469	0.0	58.7	"

C10

Results at 50°

1.017	4.91	0.0	KClO ₄
1.158	6.10	18.2	"
1.264	6.29	30.6	"
1.349	6.23	39.6	"
1.417	5.99	46.2	"
1.468	5.73	51.0	" + NaNO ₃
1.454	3.56	52.0	NaNO ₃

Results at 100°

1.068	18.17	0.0	KClO ₄
1.241	16.19	22.7	"
1.370	14.81	37.1	"
1.472	13.41	47.4	"
1.535	12.44	53.6	"
1.578	11.89	57.1	" + NaNO ₃
1.554	8.21	59.4	NaNO ₃
1.540	5.17	61.0	"
1.507	0.0	61.7	"

SOLUBILITY OF POTASSIUM PERCHLORATE IN AQUEOUS
SOLUTIONS OF SODIUM CHLORIDE.

(Corneé and Neumeister, 1929.)

d. of sat. sol.	Gms. per 100 gms. sat. sol.		Solid Phase	d. of sat. sol.	Gms. per 100 gms. sat. sol.		Solid Phase
	KClO ₄	NaNO ₃			KClO ₄	NaNO ₃	

Results at 0°

1.005	0.75	0.0	KClO ₄
1.214	0.74	26.2	" + NaCl
1.209	0.0	26.4	NaCl

Results at 75°

1.036	10.36	0.0	KClO ₄
1.207	6.18	27.5	" + NaCl
1.176	0.0	27.5	NaCl

Results at 25°

1.013	2.03	0.0	KClO ₄
1.207	1.61	25.9	" + NaCl
1.198	0.0	26.6	NaCl

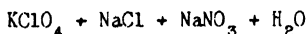
Results at 100°

1.068	18.17	0.0	KClO ₄
1.116	15.12	8.1	"
1.151	12.72	15.0	"
1.190	10.85	21.0	"
1.216	9.49	25.1	" + NaCl
1.201	6.85	36.0	NaCl
1.181	3.54	37.0	"
1.161	0.0	37.6	"

Results at 50°

1.017	4.71	0.0	KClO ₄
1.205	3.19	25.9	" + NaCl
1.185	0.0	26.0	NaCl

The following results are given by Cornec & Neumeister, 1929 for the quarternary system.



t°	d. of sat. sol.	Gms. per 100 gms. sat. sol.			Solid Phase
		KClO ₄	NaCl	NaNO ₃	
0	1.342	1.15	16.4	23.4	KClO ₄ + NaCl + NaNO ₃
25	1.404	3.19	4.1	41.7	" + NaNO ₃
"	1.395	2.84	8.4	36.9	" + "
"	1.388	2.55	12.3	32.5	" + " + NaCl
"	1.332	2.31	16.0	23.4	" + NaCl
"	1.274	2.00	20.5	13.0	" + "
"	1.378	1.28	12.8	32.3	" + NaNO ₃
50	1.445	4.76	8.6	41.3	KClO ₄ + NaCl + NaNO ₃
"	1.398	4.60	11.1	34.6	" + "
"	1.341	4.34	14.6	25.7	" + "
"	1.277	3.84	19.6	14.3	" + "
75	1.509	7.69	5.9	48.3	KClO ₄ + NaCl + NaNO ₃
"	1.454	7.67	8.1	41.5	" + "
"	1.384	7.51	11.7	31.5	" + "
"	1.305	6.92	17.1	18.6	" + "
100	1.578	11.54	2.20	55.1	KClO ₃ + NaNO ₃
"	1.538	5.86	4.79	55.5	NaCl + "
"	1.573	10.80	4.23	53.6	" + " + KClO ₄
"	1.518	11.52	5.73	47.0	" + KClO ₄
"	1.440	11.72	8.84	37.0	" + "
"	1.340	11.34	14.71	22.1	" + "

ClO

SOLUBILITY OF POTASSIUM PERCHLORATE IN AQUEOUS SOLUTIONS OF ETHYL ALCOHOL AT 14°.

(Pierrat, 1921.)

Saturation was obtained by constant agitation for several hours. The saturated solution was evaporated to dryness in a current of air and the residue dissolved in enough water to yield the original volume of the solution. The salt content of this solution was then determined by electrolytic conductivity measurement.

Wt. per cent C ₂ H ₅ OH in solvent.	Gms. KClO ₄ per liter sat. sol.	Wt. per cent C ₂ H ₅ OH in solvent.	Gms. KClO ₄ per liter sat. sol.
0.0	12.4	42.4	3.9
7.1	9.2	58.5	2.6
13.2	7.8	94.7	0.15
27.3	5.7		

SOLUBILITY OF POTASSIUM PERCHLORATE IN AQUEOUS SOLUTIONS OF ETHYL ALCOHOL.

(Flatt, 1933; Flatt and Jordan, 1930, 1933.)

t°	Vol. Percent C ₂ H ₅ OH in Solvent	Gms. KClO ₄ per 100 gms. sat. sol.	t°	Vol. Percent C ₂ H ₅ OH in Solvent	Gms. KClO ₄ per 100 gms. sat. sol.
25	0 (= H ₂ O)	2.065	40	50	1.422
"	50	0.790	"	75	0.548
"	75	0.313			

100 gms.	51.2 Vol. % Aq. C_2H_5OH	($d = 0.9319$)	dissolve 0.754 gm. $KClO_4$ at 25.2°	(Thin and Cumming, 1915.)
"	93.5 " "	($d = 0.8219$)	" 0.051 gm. $KClO_4$ at 25.2°	(Thin and Cumming, 1915.)
"	98.8 " "	($d = 0.7998$)	" 0.019 gm. $KClO_4$ at 25.2°	(Thin and Cumming, 1915.)
"	90 Wt. % Aq. C_2H_5OH		" 0.036 gm. $KClO_4$ at 25.2°	(Wenze, 1891.)
"	97.2 " "		" 0.0156 gm. $KClO_4$ at 25.2°	(Wenze, 1891.)

SOLUBILITY OF POTASSIUM PERCHLORATE IN AQUEOUS AND IN ALCOHOLIC SOLUTIONS OF PERCHLORIC ACID AT 25.2° .
(Thin and Cumming, 1915.)

In Aq. $HClO_4$ Solutions.		In Alcoholic $HClO_4$ Solutions.	
Normality of Aq. $HClO_4$.	Gms. $KClO_4$ per 100 Gms. Sat. Sol.	Aqueous Solvent.	Gms. $KClO_4$ per 100 Gms. Sat. Sol.
0 (= water)	2.085	93.5% Alcohol	0.051
0.01	1.999	+ 0.2% $HClO_4$ *	0.0175
0.10	1.485	98.8% Alcohol +	0.010
I	0.527	+ 2% $HClO_4$ *	0.028

* The $HClO_4$ was added as aq. 20% $HClO_4$ solution hence the concentration of the alcohol was decreased.

SOLUBILITY OF POTASSIUM PERCHLORATE AND ABSOLUTE ETHYL ALCOHOL SOLUTION OF AMMONIUM SALTS AT 25° .
(Seward and Schumb, 1930.)

Results for C_2H_5OH ($d = 0.7852$) Solutions of:

Ammonium Nitrate		Ammonium Perchlorate		Ammonium Iodide	
Gm. Mols. per liter		Gm. Mols. per liter		Gm. Mols. per liter	
NH_4NO_3	$KClO_3$	NH_4ClO_4	$KClO_4$	NH_4I	$KClO_4$
0.000000	0.0005654	0.000000	0.0005654	0.000495	0.0006148
0.000254	0.0005986	0.000222	0.0004979	0.000856	0.0006493
0.000488	0.0006333	0.000514	0.0004087	0.001141	0.0006784
0.000971	0.0006773	0.001004	0.0003251	0.001518	0.0007068
0.001858	0.0007283	0.001742	0.0002536	0.001765	0.0007156
0.004345	0.0008396			0.002343	0.0007462

SOLUBILITY OF POTASSIUM PERCHLORATE IN SEVERAL SOLVENTS AT 28° .
(Willard and Smith, 1923.)

d_4^{25} of		d_4^{25} of		Gms. $KClO_4$ per 100 gms. sat. sol.	
Solvent.	sat. sol.	Solvent	sat. sol.	Solvent	sat. sol.
Water.....	1.0096	n Butyl alcohol..	0.8060		0.0045
Ethyl alcohol....	0.7852	iso " " ..	0.7981		0.005
Methyl alcohol..	0.7878	Acetone.....	0.7868		0.155
n Propyl alcohol.	0.8011	Ethyl acetate....	0.8945		0.0015

AT $25^{\circ} \pm 3$. (Smith, 1923 a.)

100 cc. pure ethyl acetate dissolve 1.3 mg. $KClO_4$ at 25°. (Smith, 1925.)

AND ALCOHOLS AT 23°. (Smith, 1925.)

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ACID SOLUTIONS OF VARIOUS SALTS AT 25°

(Seward and Hamblet, 1932; Scholl and Hutchinson and Chandless, 1933.)

Results for CH_3COOH ($d_{25} = 1.044$) solutions of:

Lithium Chloride

Magnesium Chloride

Ammonium Perchlorate

Gm. Mols. per liter		Gm. Mols. per liter		Gm. Mols. per liter	
LiCl	KClO ₄	MgCl ₂	KClO ₄	NH ₄ ClO ₄	KClO ₄
0.00000	0.000196	0.0000042	0.000228	0.000198	0.000194
0.00070	0.000293	0.0000115	0.000250	0.000316	0.000176
0.00141	0.000360	0.0000314	0.000276	0.000378	0.000190
0.00285	0.000524	0.0000420	0.000297	0.000509	0.000171
0.00641	0.000701	0.0000829	0.000336	0.000765	0.000155
0.00943	0.000767	0.0001440	0.000347	0.000983	0.000155
0.02870	0.001265	0.0002820	0.000394	0.001306	0.000139
		0.0005390	0.000475	0.002093	0.000141

Sodium Bromide

Sodium Bromide

Sodium Nitrate

Gm. Mols. per liter		Gm. Mols. per liter		Gm. Mols. per liter	
NaBr	KClO ₄	NaBr	KClO ₄	NaNO ₃	KClO ₄
0.000078	0.000233	0.00000	0.000195	0.00000	0.000195
0.000120	0.000247	0.000078	0.000235	0.000168	0.000253
0.000192	0.000288	0.000120	0.000270	0.000346	0.000305
0.000210	0.000314	0.000192	0.000290	0.000633	0.000357
0.000278	0.000329	0.000210	0.000288	0.001009	0.000413
0.000590	0.000387	0.000278	0.000310	0.001550	0.000483
0.000700	0.000409	0.000590	0.000379	0.001825	0.000522

POTASSIUM CHROMATES K_2CrO_4 , $K_2Cr_2O_7$, $K_2Cr_2O_{10}$, etc.

EQUILIBRIUM IN THE SYSTEM, POTASSIUM OXIDE, CHROMIC ACID AND WATER AT SEVERAL TEMPERATURES.

(Koppel and Blumenthal, 1907.)

CrO

Results at 0°.		Results at 30°.		Results at 60°.		Solid Phase at each Temp.
Gms. per 100 Gms. Sat. Solution.		Gms. per 100 Gms. Sat. Solution.		Gms. per 100 Gms. Sat. Solution.		
K_2O .	CrO_3 .	K_2O .	CrO_3 .	K_2O .	Cr_2O_3 .	
31.18	...	46.8	...	about 50	...	$KOH \cdot 2H_2O$
26.06	0.54	26.80	0.94	32.08	0.53	K_2CrO_4 *
19.31	4.27	22.25	3.06	21.05	9.15	"
17.06	11.77	18.65	13.72	20.25	14.43	"
17.62	18.71	19.12	20.30	20.70	21.07	"
17.73	19.04	19.35	21	20.61	23.61	" + $K_2Cr_2O_7$
10.90	11.93	15.04	16.85	14.53	20.82	$K_2Cr_2O_7$
1.87	3.13	11.20	13.11	10.01	21.21	"
0.78	22.38	2.42	28.21	6.86	39.64	"
1.47	42.95	2.50	44.50	7.06	49.84	" + $K_2Cr_2O_{10}$
1.25	44.52	...	...	4.06	54.73	$K_2Cr_2O_{10}$
1.17	46.84	...	...	2	60.69	"
1.37	47.40	2.35	49.95	...	...	" + $K_2Cr_2O_{10}$
1.24	48.23	1.35	53.39	...	...	$K_2Cr_2O_{10}$
1.16	56.93	...	...	...	...	"
0.64	61.79	0.69	62.81	1.27	65.77	" + CrO_2
0	61.54	...	62.52	0	65.12	CrO_3

THE CRYOHYDRATES (EUTECTICS) IN THE SYSTEM $K_2O - CrO_3 - H_2O$.

The points were determined by adding to a sat. solution of $K_2Cr_2O_7$ successive 1 to 2 gm. portions of chromic acid and ascertaining the freezing-point and composition of the solution. At the point of appearance of a new solid phase an additional amount of chromic acid does not change the f.-pt. since the added CrO_3 goes into the solid phase. This relation also holds at the points where the solution is simultaneously saturated with $K_2Cr_2O_7$ and $K_2Cr_2O_{10}$ or $K_2Cr_2O_{10}$ and $K_2Cr_2O_{13}$.

t° of Equilibrium of Sat. Sol. with Ice.	Gms. per 100 Gms. Sat. Solution.		Solid Phase in Equilibrium with Sat. Sol. and Ice.	t° of Equilibrium of Sat. Sol. with Ice.	Gms. per 100 Gms. Sat. Solution		Solid Phase in Equilibrium with Sat. Sol. and Ice.
	K_2O .	CrO_3 .			K_2O .	CrO_3 .	
-25	20	5.70	K_2CrO_4	-13.22	not det.	27.26	$K_2Cr_2O_7$
-13	17.52	13.89	"	-14.50	"	28.85	"
-11.37	17.12	18.18	"	-22.10	"	35.92	"
-11.50	17.18	18.11	" + $K_2Cr_2O_7$	-22.11	0.47	36.14	"
-5	8.27	8.01	$K_2Cr_2O_7$	-26.77	0.88	39.86	"
-0.63	1.38	2.93	"	-30.20	1.18	42.31	" + $K_2Cr_2O_{10}$
-1.78	not det.	6.81	"	-34.01	0.95	43.45	$K_2Cr_2O_{10}$
-5.5	"	16.05	"	-39	0.79	45.65	" + $K_2Cr_2O_{10}$
-6.43	0.48	17.25	"	-49	not det.	49.11	$K_2Cr_2O_{10}$
-10.25	0.45	23.63	"	-61.5	0.61	53.57	"

The viscosity of the solutions at the lower temperatures increased so much that the cryohydrate points could not be determined. By graphic extrapolation the cryohydrate temperature of chromic acid and of chromic acid + potassium tetrachromate is near -80° and the CrO_3 content is 59 gms. per 100 gms. sat. solution.

By interpolation from the data given in the preceding tables the following solubilities in water are obtained:

THE ICE CURVE AND SOLUBILITY OF POTASSIUM CHROMATE IN WATER.

t°.	Gms. K_2CrO_4 per 100 Gms. H_2O .	Solid Phase.	t°.	Gms. K_2CrO_4 per 100 Gms. H_2O .	Solid Phase.
-0.99	4.53	Ice	-11.35	Eutec. 54.54	Ice + K_2CrO_4
-1.2	6.12	"	0	57.11	K_2CrO_4
-4.3	26.99	"	30	65.13	"
-7.12	42.04	"	60	74.60	"
-10.35	52.41	"	105.8 b. pt.	88.8	"

Potassium Dichromate

Potassium Dichromate + Potassium Chromate.

Potassium Dichromate + Potassium Trichromate.

t°.	Gms. $K_2Cr_2O_7$ per 100 Gms. H_2O .	t°.	Gms. per 100 Gms. H_2O .	t°.	Gms. per 100 Gms. Sat. Solution.
			K_2O CrO_3		K_2O CrO_3
-0.63*	4.50	-11.5*	17.18 18.11	-30*	1.18 42.51
0	4.65	0	17.73 19.03	0	1.47 42.99
30	18.13	+30	19.35 21	+20	2.20 43.10
60	45.44	60	20.61 23.61	30	2.50 44.50
104.8†	108.2	106.8†	24.3 30.5	60	7.06 49.84
				114†	16.80 59.20

* Eutec.

† b. pt.

Potassium Trichromate + Potassium Tetrachromate.

Potassium Tetrachromate + Chromic Acid (CrO_3).

t°.	Gms. per 100 Gms. Sat. Sol.	t°.	Gms. per 100 Gms. Sat. Sol.
	K_2O CrO_3		K_2O CrO_3
-39 Eutec.	0.79 45.69	0	0.64 61.79
0	1.37 47.40	20	0.62 62.80
20	2 48.46	30	0.69 62.81
30	2.25 49.95	60	1.27 65.77
60	5.01 54.09		

Data for boiling points in the system $K_2O + CrO_3 \cdot H_2O$ determined by means of the Beckmann apparatus, are also given.

The older data for K_2CrO_4 and $K_2Cr_2O_7$ are as follows:

SOLUBILITY OF EACH IN WATER.

(Alluard, 1863; Nordenskjöld and Lindström, 1869; Etard, 1894; Kremers, 1854; Tilden and Shennstone, 1884.)

t°.	Potassium Chromate.			Potassium Dichromate.	
	Grams per 100 Grams Water.			Grams per 100 Grams Water.	
0	58.2*	59.3†	60.2‡	5*	5§
10	60.0	61.2	62.5	7	7
20	61.7	63.2	64.5	12	12
25	62.5	64.2	64.5	16	16
30	63.4	65.2	66.5	20	20
40	65.2	67.0	68.6	26	27
50	66.8	69.0	70.6	34	37
60	68.6	71.0	72.7	43	47
70	70.4	73.0	74.8	52	58
80	72.1	75.0	76.9	61	70
90	73.9	77.0	79.0	70	82
100	75.6	79.0	82.2	80	97
125	79.0	110	145
150	83.0	143	205

* Etard.

† Alluard.

‡ N. and L.

§ A., K., T. and S.

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SOLUBILITY OF POTASSIUM CHROMATES IN WATER AT 30°.

(Schreinemaker -- Z. physik. Ch. 55, 83, '06.)

Composition in Wt per cent of:

The Solution		The Residue.		Solid Phase.
Percent CrO ₃	Percent K ₂ O.	Percent CrO ₃	Percent K ₂ O.	
0	± 47	...	...	KOH.H ₂ O
0.0	47.16	12.59	47.54	K ₂ CrO ₄
0.1775	34.602	10.93	37.47	"
1.351	26.602	16.482	32.532	"
5.598	20.584	37.131	39.922	"
15.407	19.225	27.966	29.377	"
20.67	19.17	...	...	K ₂ CrO ₄ + K ₂ Cr ₂ O ₇
19.096	17.30	37.64	22.61	K ₂ Cr ₂ O ₇
11.35	7.88	...	...	"
17.93	3.412	25.85	7.82	"
43.51	3.01	49.45	9.91	"
44.46	3.245	53.94	12.40	K ₂ Cr ₂ O ₇ + K ₂ Cr ₂ O ₈
46.368	2.823	60.314	12.935	K ₂ Cr ₂ O ₁₀
49.357	2.353	63.044	11.084	K ₂ Cr ₂ O ₁₀ + K ₂ Cr ₂ O ₁₁
53.215	1.300	62.958	8.002	K ₂ Cr ₂ O ₁₁
62.55	0.796	67.944	6.731	"
62.997	0.621	70.0	4.0	K ₂ Cr ₂ O ₁₁ + CrO ₃
62.28	0.0	...	...	CrO ₃

CrO

100 gms. sat. solution in glycol, C₂H₄(OH)₂.H₂O, contain 1.7 gms. K₂CrO₄ at 15.4°.

100 gms. sat. solution in glycol, C₂H₄(OH)₂.H₂O, contain 6 gms. K₂Cr₂O₇ at 14.6°.

(de Coninck, 1905.)

100 gms. H₂O dissolve 10.1 gms. K₂Cr₂O₇ at 15.5°.

(Greenish and Smith, 1901.)

100 gms. sat. solution in water contain 5.52 gms. K₂Cr₂O₇ at 4.81°, 15.17 gms. at 30.1° and 17.77 gms. at 35.33°.

(Le Blanc and Schmandt, 1911.)

100 cc. sat. aqueous solution contain 11.43 gms. K₂Cr₂O₇ at 20°.

(Sherrill and Eaton, 1907.)

SOLUBILITY OF POTASSIUM CHROMATES IN WATER.

(Flotmann, 1899.)

Results for Potassium Chromate

Results for Potassium Di Chromate

t°	g. of sat. sol.	Gms. K ₂ CrO ₄ per 100 gms. sat. sol.
15	1.3749	38.49
20	1.3785	38.94
25	1.3805	39.38

t°	g. of sat. sol.	Gms. K ₂ Cr ₂ O ₇ per 100 gms. sat. sol.
15	1.0615	8.893
20	1.0768	10.822
25	1.0916	12.98

The following more recent determinations of the Solubility of Potassium DiChromate in Water are given by Rakowski and Babajewa, 1931.

t°	0	20	40	60	80	100
Gms. K ₂ Cr ₂ O ₇ per 100 gms. sat. sol.	4.47	10.97	20.83	31.3	42.20	50.0

SOLUBILITY OF POTASSIUM CHROMATE IN WATER
AT TEMPERATURES ABOVE 100°.

(Benrath, Qjedebo, Schiffers and Wunderlich, 1937.)

The authors' results were plotted and the following values taken from the average curve.

t°	Gms. K_2CrO_4 per 100 gms. sat. sol.	t°	Gms. K_2CrO_4 per 100 gms. sat. sol.	t°	Gms. K_2CrO_4 per 100 gms. sat. sol.
100	44.0	180	48.5	260	52.6
120	45.5	200	49.6	280	53.6
140	46.5	220	50.6	300	54.6
160	47.8	240	51.6	320	55.7

SOLUBILITY OF POTASSIUM CHROMATE IN AQUEOUS SOLUTIONS
OF SEVERAL SALTS EACH DETERMINED SEPARATELY AT 25°.

(Herz and Hieenthal, 1929.)

Results for Aqueous Solutions of:

Potassium Bromide	Potassium Chloride	Magnesium Chloride	Sodium Chloride	Ammonium Chloride			
Gm. Mol. per liter KBr $1/6 K_2CrO_4$	Gm. Mol. per liter KCl $1/6 K_2CrO_4$	Gm. Mol. per liter $1/2 MgCl_2$ $1/6 K_2CrO_4$	Gm. Mol. per liter $NaCl$ $1/6 K_2CrO_4$	Gm. Mol. per liter NH_4Cl $1/6 K_2CrO_4$			
0.00	8.35	0.0	8.35	0.42	8.22	0.45	7.68
0.41	7.56	0.40	7.76	0.42	7.58	0.86	6.92
0.82	6.91	0.46	7.69	0.86	6.11	1.73	5.58
1.24	6.26	1.31	6.48	1.73	4.30	2.59	5.00
1.78	5.50	1.72	5.89	2.27	2.74	3.30	4.43
2.19	5.00	2.18	5.24	2.76	1.30	3.40	3.49
2.70	4.38	2.70	4.75	3.26	1.04	4.25	2.87

Cr

SOLUBILITY OF POTASSIUM CHROMATE IN AQUEOUS SOLUTIONS OF POTASSIUM
MOLYBDATE AT 25° AND VICE VERSA.

(Amadori, 1912a.)

Gms. per 100 Gms. H ₂ O.		Gms. per 100 Gms. H ₂ O.		Gms. per 100 Gms. H ₂ O.	
K ₂ CrO ₄ .	K ₂ MoO ₄ .	K ₂ CrO ₄ .	K ₂ MoO ₄ .	K ₂ CrO ₄ .	K ₂ MoO ₄ .
64.62	0	14.13	98.72	4.92	165.4
49.59	15.37	10.07	118.8	2.14	180.8
38.90	38.79	10.24	119.9	1.70	183
33.21	50.96	7.12	137.8	0	184.6
		6.37	157.2		

SOLUBILITY OF POTASSIUM CHROMATE IN AQUEOUS SOLUTIONS OF
POTASSIUM SULFATE AT 25° AND VICE VERSA.

(Amadori, 1912a.)

Gms. per 100 Gms. H ₂ O.		Gms. per 100 Gms. H ₂ O.		Gms. per 100 Gms. H ₂ O.	
K ₂ CrO ₄ .	K ₂ SO ₄ .	K ₂ CrO ₄ .	K ₂ SO ₄ .	K ₂ CrO ₄ .	K ₂ SO ₄ .
63.09	0.76	40.93	3.33	7.81	8.98
61.39	1.17	27.36	4.82	4.36.	10.25
58.40	1.84	20.83	5.72	1.94	10.86
51.81	2.36	14.65	7.12	0	12.10

100 cc. anhydrous hydrazine dissolve 1 gm. K_2CrO_4 at room temp. } (Welsh and Brod-
100 cc. anhydrous hydrazine dissolve 1 gm. $K_2Cr_2O_7$ at room temp. } erson, 1915.)

SOLUBILITY OF MIXED CRYSTALS OF POTASSIUM SULFATE AND POTASSIUM
CHROMATE AT 25°
(Fock, 1897.)

Milligram Mols. per Liter.		Grams per Liter.		Mol. per cent K_2SO_4 in Solution.	Sp. Gr. of Solution.	Mol. per cent K_2SO_4 in Solid Phase.
K_2SO_4 .	K_2CrO_4 .	K_2SO_4 .	K_2CrO_4 .			
618.1	0.0	107.7	0.00	100.0	1.083	100.0
608.4	103	106.0	20.02	85.51	1.092	99.65
341.0	691.8	59.46	134.5	33.01	1.141	97.30
174.8	1496.0	30.47	290.5	10.50	1.231	91.97
110.7	2523	19.30	490.5	4.21	1.356	28.43
100.6	2687	17.54	522.3	3.60	1.377	2.41
0.0	2847	0.0	553.5	0.00	1.398	0.00
734.0	0.0	127.9	0.0	100.0	1.0863	100.0
617.0	103.4	107.6	20.1	85.65	1.0934	99.78
463	452.7	80.72	88.0	55.55	1.1235	98.49
279	948.2	48.64	184.4	22.72	1.1700	96.07
153	1469	26.68	285.6	9.41	1.2255	85.77
296	2681	51.61	521.2	21.09	1.3688	25.73
0.0	2715	0.00	527.8	0.00	1.3781	0.00

THE SYSTEM AMMONIUM CHROMATE + POTASSIUM CHROMATE + WATER AT 25°
(Araki, 1925)

CrO

Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase
K_2CrO_4 .	$(NH_4)_2CrO_4$.		K_2CrO_4 .	$(NH_4)_2CrO_4$.	
39.35	0.00	K_2CrO_4	15.82	19.98	Mixtures of the two series of solid solutions
36.77	1.41		15.20	20.18	
34.38	3.25		14.55	20.36	
29.36	6.75	Series of solid solutions of $(NH_4)_2CrO_4$ in K_2CrO_4	14.47	20.40	Series of solid solutions of K_2CrO_4 in $(NH_4)_2CrO_4$
25.89	10.01		14.14	20.70	
22.35	12.85		11.69	21.10	
18.64	16.51		10.63	21.94	
16.07	19.10		7.68	22.88	
15.84	19.95		4.53	24.43	

A STUDY OF THE RECIPROCAL SALT PAIR $[(NH_4)_2, K_2] [CrO_4, SO_4]$ AT 25°
(Ishikawa, 1926)

Previous experiments have shown that $K_2SO_4 + K_2CrO_4$ and also $(NH_4)_2SO_4 + K_2SO_4$ each form a complete series of solid solutions with no gap, while $(NH_4)_2CrO_4 + (NH_4)_2SO_4$ and $(NH_4)_2CrO_4 + K_2CrO_4$ each form a series of solid solutions with gaps respectively at 2.90 to 21.51 and 16.75 to 55.50 molar percentages of ammonium chromate. The present experiments were made by adding to a solution in equilibrium with two kinds of solid solutions of two salts having a common ion, another salt in different proportion, in such a manner that when equilibrium is attained, two or three solid phases remained as residue. The mixtures were rotated in a thermostat for at least two days. The results of the analyses are given in a table and plotted in the Jancke square diagram.

AMMONIUM Lanthanum CHROMATE $3(NH_4)_2CrO_4 \cdot La(CrO_4)_3 \cdot 5H_2O$.

Data showing that the range of existence of the double ammonium lanthanum chromate is in the presence of aqueous solutions containing from 5.06 to 23.22 per cent of ammonium chromate, are given by Carobbi, 1926.

POTASSIUM DICHROMATE $K_2Cr_2O_7$.

SOLUBILITY OF POTASSIUM DICHROMATE IN AQUEOUS SOLUTIONS
OF SODIUM DICHROMATE AND VICE VERSA. (Robertson, 1924.)

The mixtures of the two salts were dissolved in water at a higher temperature than that of the isotherm and the flasks then placed in a thermostat at the desired temperature. Constant agitation is not mentioned.

Results at 25°.		Results at 50°.		Results at 100°.		Solid Phase at each temperature.
Gms. per 100 gms. sat. sol.		Gms. per 100 gms. sat. sol.		Gms. per 100 gms. sat. sol.		
$Na_2Cr_2O_7$.	$K_2Cr_2O_7$.	$Na_2Cr_2O_7$.	$K_2Cr_2O_7$.	$Na_2Cr_2O_7$.	$K_2Cr_2O_7$.	$K_2Cr_2O_7$
0.0	13.1	0.0	27.4	0.0	47.2	
4.38	12.2	6.5	24.2	6.3	42.1	»
16.1	8.68	16.3	19.3	14.1	36.5	»
20.0	8.97	21.0	17.8	23.0	29.0	»
26.9	7.70	29.3	13.6	29.6	24.2	»
33.6	6.52	43.6	11.3	44.4	16.4	»
43.2	5.46	48.5	9.47	56.1	13.4	»
55.5	5.16	52.5	9.36	60.6	12.4	»
61.4	5.25	63.3	7.92	70.8	9.96	» $Na_2Cr_2O_7$
65.5	0.0	70.3	0.0	80.1	0.0	$Na_2Cr_2O_7$

SOLUBILITY OF POTASSIUM DICHROMATE IN AQUEOUS SOLUTIONS
OF POTASSIUM CHLORIDE AND VICE VERSA. (Robertson, 1924.)

Results at 25°.		Results at 50°.		Results at 100°.		Solid Phase at each temperature.
Gms. per 100 gms. sat. sol.		Gms. per 100 gms. sat. sol.		Gms. per 100 gms. sat. sol.		
KCl.	$K_2Cr_2O_7$.	KCl.	$K_2Cr_2O_7$.	KCl.	$K_2Cr_2O_7$.	$K_2Cr_2O_7$
2.1	10.0	2.4	25.8	0.0	47.2	
4.3	8.3	4.6	21.3	3.5	42.1	»
6.32	6.53	6.6	18.9	7.2	37.1	»
8.2	5.5	8.6	16.7	11.4	32.2	»
10.0	4.55	10.6	14.9	15.6	27.6	»
11.6	3.9	11.9	13.2	22.1	20.6	»
13.0	3.36	13.3	12.4	24.9	18.2	»
15.7	2.6	14.8	11.0			»
18.6	2.2	18.1	8.8			»
21.2	1.7	21.4	6.8			»
23.0	1.57	24.0	5.7			»
26.0	1.2	28.9	4.1	27.6	16.2	» + KCl
—	—	29.0	3.7	29.6	11.6	KCl
26.1	1.05	29.8	1.9	31.9	6.4	»
26.3	0.0	30.6	0.0	35.9	0.0	»

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POTASSIUM DICHROMATE $K_2Cr_2O_7$.

SOLUBILITY OF POTASSIUM DICHROMATE IN AQUEOUS SOLUTIONS
OF SEVERAL SALTS, EACH DETERMINED SEPARATELY AT 25°.

(Hertz and Hiebsenthal, 1920.)

Results for Aqueous Solutions of:

Calcium Chloride		Magnesium Chloride		Strontium Chloride	
Gm. Mols. per liter		Gm. Mols. per liter		Gm. Mols. per liter	
$1/2-CaCl_2$	$1/6-K_2Cr_2O_7$	$1/2-MgCl_2$	$1/6-K_2Cr_2O_7$	$1/2-SrCl_2$	$1/6-K_2Cr_2O_7$
0.24	2.88	0.0	2.89	0.0	2.89
0.45	2.91	0.45	2.78	0.51	2.89
0.92	2.84	0.93	2.64	1.00	2.91
1.41	3.69	1.84	2.24	2.02	2.73
1.64	2.62	2.31	2.07	2.23	2.69
1.87	2.56	2.74	1.91	2.84	2.62
11.42	1.88	3.15	1.76	3.47	2.38

Lithium Chloride		Sodium Chloride		Ammonium Chloride	
Gm. Mols. per liter		Gm. Mols. per liter		Gm. Mols. per liter	
$LiCl$	$1/6-K_2Cr_2O_7$	$NaCl$	$1/6-K_2Cr_2O_7$	NH_4Cl	$1/6-K_2Cr_2O_7$
0.0	2.89	0.47	2.91	0.0	2.89
0.49	2.73	0.94	2.98	0.73	2.52
0.92	2.55	1.91	2.79	1.79	2.54
1.78	2.26	2.84	2.62	2.59	2.32
2.78	1.85	3.80	2.33	3.10	2.16
3.61	1.57	4.21	2.24	4.00	1.83
4.49	1.32	5.03	2.06	5.12	0.91

CrO

POTASSIUM CHROMATES

SOLUBILITY OF POTASSIUM CHROMATE AND OF POTASSIUM
DICHROMATE IN AQUEOUS SOLUTIONS OF DIOXANE AT 25°.

(Hertz and Lorenz, 1929.)

Results for:

Potassium Chromate		Potassium Dichromate	
cc Dioxane, ($C_4H_8O_2$), per 100 cc aq. solvent	Gm. Mols. K_2CrO_4 per liter sat. sol.	cc Dioxane ($C_4H_8O_2$) per 100 cc aq. solvent	Gm. Mols. $K_2Cr_2O_7$ per liter sat. sol.
5.0	1.21	10	0.41
9.0	1.08 L	33	0.25
55.0	0.05 U	50	0.15
80	0.02	60	0.01

L = Lower liquid layer U = Upper liquid layer

SOLUBILITY OF POTASSIUM CHROMATE IN AQUEOUS
SOLUTIONS OF URETHAN AT 25°.
(Palitsch, 1928, 1929.)

Gm. Mols. per 1000 gms. H ₂ O		Solid Phase
K ₂ CrO ₄	NH ₂ COOC ₂ H ₅	
3.323	0.0	K ₂ CrO ₄
0.1	49.61	Upper liquid layer
3.0	0.396	Lower liquid layer

Fusion-point Data are given for the following mixtures.

K ₂ CrO ₄ + K ₂ Cr ₂ O ₇ (Groschuff, 1908.)	K ₂ Cr ₂ O ₇ + K ₂ Mo ₂ O ₇ (Anadori, 1913.)
" + K ₂ Mo ₂ O ₇ (Anadori, 1913.)	" + K ₂ W ₂ O ₇ "
" + K ₂ WO ₄ "	" + Na ₂ Cr ₂ O ₇ (Lehrman, Selditch and Skell, 1936.)
" + K ₂ SO ₄ (" ; Groschuff, 1908.)	

POTASSIUM FLUORIDE KF.2H₂O

SOLUBILITY OF POTASSIUM FLUORIDE IN WATER.
(Jatlov and Poljakova, 1928.)

t°	Gms. KF per 100 gms. sat. sol.	Solid Phase	t°	Gms. KF per 100 gms. sat. sol.	Solid Phase	
-3.2	5.0	Ice	20	43.70	KF.2H ₂ O	F
-6.5	10.0	"	25	50.41	"	
-12.2	15.0	"	30	51.95	"	
-19.5	20.0	"	35	54.65	"	
-21.8 Eutec.	21.5	" + KF.4H ₂ O	40.2 tr.pt.	58.08	" + KF	
-20.0	22.7	KF.4H ₂ O	0	44.30*	"	
0	30.90	"	17.5	47.52*	"	
10	34.87	"	45	58.62	KF	
15	38.13	"	60	58.72	"	
17.5	41.52	"	80	60.01	"	
17.7	47.7	" + KF.2H ₂ O				

* Metastable

100 gms. sat. solution of Potassium Fluoride in Water contain 48.0 gms. KF at 18° and the Sp. Gr. of the solution = 1.502. (Mylus and Funk, 1897.)

Determinations by Forcrand, 1911, at 18° gave 45.3 gms. KF per 100 gms. aqueous solution in contact with KF.2H₂O as solid phase and 35.96 gms. KF per 100 gms. aq. solutions sat. with KF.4H₂O as solid phase.

SOLUBILITY OF POTASSIUM FLUORIDE IN HYDROFLUORIC ACID AT 21°.
(Ditte, 1896.)

Gms. per 100 Gms. H ₂ O.		Gms. per 100 Gms. H ₂ O.		Gms. per 100 Gms. H ₂ O.	
HF.	KF.	HF.	KF.	HF.	KF.
0.0	96.3	9.25	29.9	20.68	38.4
1.21	72.0	11.36	29.6	28.60	40.9
1.61	61.0	12.50	30.5	41.98	61.8
3.73	40.4	13.95	31.4	53.71	74.8
4.03	32.5	15.98	33.4	74.20	105.0
6.05	30.4	17.69	35.62	119.20	109.5

100cc sat. solution of Potassium Fluoride in liquid hydrofluoric acid contain 38.0 gms. KF at 0°. (Fredenhagen 1930, 1933; Fredenhagen and Cadenback, 1931.)

K KALIIUM POTASSIUM FLUORIDE

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FREZZING-POINTS OF MIXTURES OF POTASSIUM FLUORIDE AND HYDROFLUORIC ACID. (Cady, 1934.)

A thermocouple thermometer was used and the freezing, eutectic and transition points were determined by cooling curves. Data for vapor pressure are also given.

t°	Mol. Fraction HF in Solution	Solid Phase	t°	Mol. Fraction HF in Solution	Solid Phase
-83.7	1.000	HF*	64.0	0.7173	KF.5HF
-85.2	0.9875	"	(64.3)	(0.714)	"
-86.9	0.9732	"	64.3	0.7115	"
-89.5	0.9580	"	63.4	0.7040	"
-92.8	0.9466	"	61.8	0.6969	" + KF.2HF
-97.0	0.9311	" + KF.4HF	62.4	0.6932	KF.2HF
-45.0	0.9143	KF.4HF	70.0	0.6777	"
8.0	0.8884	"	71.7	0.6670	"
48.0	0.8572	"	71.1	0.6606	"
63.2	0.8355	"	68.3	(0.649)	" + α .KF.HF
67.7	0.8241	"	84.	0.6435	α KF.HF
71.8	0.8086	"	128	0.6197	"
(72.0)	(6.8000)	"	148	0.6014	"
72.0	0.7993	"	175	0.5695	"
71.0	0.7901	"	189	0.5488	"
67.8	0.7783	"	195	0.5382	" + β KF.HF
(63.6)	(0.771)	" + KF.3HF	217	0.5218	β KF.HF
64.4	0.7676	KF.3HF	231	0.5103	"
65.4	0.7583	"	234	0.5075	"
(65.8)	(0.7500)	"	236.8	0.5032	"
65.8	0.7490	"	(239.0)	(0.5000)	"
65.5	0.7438	"	238.8	0.4996	"
64.5	0.7342	"	236	0.4847	"
62.6	0.7278	"	229.5	0.4860	" + KF
62.4	(0.727)	" + 2KF.5HF	292	0.4775	KF
62.7	0.725	KF.5HF	346	0.4646	"

POTASSIUM Acid FLUORIDE KHF₂.

SOLUBILITY OF POTASSIUM ACID FLUORIDE IN WATER.

(Jutiev and Poljonoval, 1934.)

t°	Gms. KHF ₂ per 100 gms. sat. sol.	Solid Phase	t°	Gms. KHF ₂ per 100 gms. sat. sol.	Solid Phase
-2.9	5.0	Ice	20	28.15	KHF ₂
-4.9	10.0	"	45	38.03	"
-7.6	16.5	" + KHF ₂	60	44.08	"
0	19.7	KHF ₂	80	51.28	"
+10	23.14	"			

POTASSIUM FLUORIDE KF

SOLUBILITY OF POTASSIUM FLUORIDE IN PURE METHYL ALCOHOL
AND IN PURE ETHYL ALCOHOL.
(Germuth, 1931.)

Results for Methyl Alcohol

t°	Gms. KF per 100 gms. sat. sol.
20	0.192
30	0.168
40	0.150
50	0.125
55	0.092

Results for Ethyl Alcohol

t°	Gms. KF per 100 gms. sat. sol.
20	0.106
30	0.096
40	0.068
50	0.023
55	0.016

100 gms. liquid Sulfur Dioxide dissolve 0.018 gm. KF at 0°. (Jander and Wickert, 1936; Jander & Ruppolt, 1937.)

1000 gms. pure acetone dissolve 0.00022 gms. KF at 18° and 0.00025 gm. at 37°, as determined by specific conductivity. (Lannung, 1932.)

F

EQUILIBRIUM IN THE SYSTEM POTASSIUM FLUORIDE, ETHYL ALCOHOL AND
WATER AT 23°-26°.
(Frankforter and Frary, 1913.)

The authors determined the binodal curve, the quadruple points and two tie lines.

Gms. per 100 Gms. Upper Layer.			Gms. per 100 Gms. Lower Layer.		
KF.	C ₂ H ₅ OH.	H ₂ O.	KF.	C ₂ H ₅ OH.	H ₂ O.
1.23	92.67	6.07*	45.33	0.67	54*
...	...	...	37.82	1.70	60.49
1.16	83.30	15.54	...	...	...
...	...	...	28.68	4.7	66.85
2.86	65.81	31.33	...	...	...
4.47	57.4	38.13	20.90	11.9	67.2†
5.47	53.04	41.49	...	...	...
...	...	...	18.55	15.6	65.85
6.93	47.52	45.55	...	...	...
8.84	41.28	49.88	15.7	21.8	62.5†
9.55	38.66	51.79	...	...	...
...	...	...	13.57	27.27	59.15
10.52	35.91	53.57	...	...	...
...	...	...	11.43	33.23	54.34
11	30	59	11	30	59†

* Quad. points.

† Tie line.

‡ Plait point approx.

A method for the determination of alcohol in unknown mixtures, based upon the above data, is described by the authors.

THE BINODAL CURVE FOR THE SYSTEM POTASSIUM FLUORIDE, PROPYL ALCOHOL
AND WATER AT 23°-20°.
(Frankforter and Frary, 1913.)

Gms. per 100 Gms. Homogeneous Liquid.			Gms. per 100 Gms. Homogeneous Liquid.		
KF.	C ₃ H ₇ OH.	H ₂ O.	KF.	C ₃ H ₇ OH.	H ₂ O.
0.17	96.78	3.05*	8.15	7.49	84.36
0.31	78.91	21.19	10	5.97	84.03
0.62	66.20	33.09	12.21	4.39	83.41
0.81	59.97	30.22	14.18	3.45	82.37
1.29	47.46	51.21	18.75	1.80	79.35
1.77	35.40	62.83	25.84	0.74	73.43
2.50	19.05	78.45	35.38	0.23	64.38
5.32	10.64	84.04	47.62	0.030	52.34*

* Quasi point.

One tie line was determined. In this case the upper layer contained 78.91% C₃H₇OH and 0.31% KF, and the lower layer contained 9.67% KF.

In this system, the effect of change in temperature is more marked than in the preceding one in which ethyl alcohol is present.

100 gms. sat. solution of potassium fluoride in 99.6% propyl alcohol contain 0.34 gm. KF at room temp. (Frankforter and Frary, 1913.)

BINODAL CURVE FOR THE SYSTEM POTASSIUM FLUORIDE, ISOPROPYL ALCOHOL
AND WATER AT 20°.
(Frankforter and Temple, 1913.)

Results in terms of gms. per 100 gms. of solvent, alcohol + water.

Gms. per 100 Gms. Solvent.			Gms. per 100 Gms. Solvent.		
KF.	CH ₃ CHOHCH ₃ .	H ₂ O.	KF.	CH ₃ CHOHCH ₃ .	H ₂ O.
51.826	1.555	98.445	12.385	21.438	78.502
38.748	2.965	97.935	5.071	59.330	40.661
26.039	6.525	93.475	3.073	65.455	34.545
17.812	12.215	87.785	1.705	82.750	17.250

BINODAL CURVE FOR THE SYSTEM POTASSIUM FLUORIDE, ALLYL ALCOHOL
AND WATER AT 20°.
(Frankforter and Temple, 1913.)

The results are given in terms of grams per 100 gms. Alcohol + Water instead of gms. per 100 gms. of the homogeneous mixture.

Gms. per 100 Gms. Solvent.			Gms. per 100 Gms. Solvent.		
KF.	CH ₂ CH ₂ CHOH.	H ₂ O.	KF.	CH ₂ CH ₂ CHOH.	H ₂ O.
45.707	2.270	97.730	7.508	35.300	64.610
38.076	3.983	96.017	6.024	42.011	57.989
30.675	5.879	94.121	4.813	47.550	52.450
24.341	7.129	92.871	3.631	54.211	45.789
20.580	9.601	90.409	2.236	59.948	36.443
17.371	11.491	88.509	1.931	65.630	34.370
13.184	17.764	82.236	1.635	68.845	31.155
10.880	22.537	77.463	1.368	71.395	28.605
8.873	29.529	70.471	1.066	75.377	24.223

BINODAL CURVE FOR THE SYSTEM POTASSIUM FLUORIDE, ACETONE, WATER
AT 20°.

(Frankforter and Cohen, 1914.)

Gms. per 100 Gms. Homogeneous Mixture.			Gms. per 100 Gms. Homogeneous Mixture.		
KF.	(CH ₃) ₂ CO.	H ₂ O.	KF.	(CH ₃) ₂ CO.	H ₂ O.
46.3	trace	53.7*	9.17	23.53	67.30
44.24	0.24	55.52	5	38.72	56.28
33.34	1	65.66	3.06	47.89	46.84
29.86	1.60	68.54	1.38	58.06	40.55
25.74	3.02	71.24	0.979	62.60	36.42
20.28	5.90	73.80	0.75	65.41	33.84
16.31	9.72	73.97	0.50	69.58	29.92
12.40	15.59	72.01	0	98	2*

* Quad. point.

Data for 4 tie lines are also given and the approximate position of the plait point is shown on the diagram.

Several points on the binodal curves at temperatures between 0° and 35° are also given.

A discussion, with examples, is given of the applicability of the above data to the determination of acetone in unknown mixtures.

BINODAL CURVE FOR THE SYSTEM POTASSIUM FLUORIDE, METHYL ETHYL KETONE AND WATER AT 20°.

(Frankforter and Cohen, 1916.)

F

Gms. per 100 Gms. Homogeneous Mixture.			Gms. per 100 Gms. Homogeneous Mixture.		
KF.	CH ₃ CO.C ₂ H ₅ .	H ₂ O.	KF.	CH ₃ CO.C ₂ H ₅ .	H ₂ O.
34.38	0.17	65.45	10.50	4.87	84.63
23.63	0.50	75.87	5.70	9.93	84.37
18.62	1.49	79.89	3.06	12.42	83.61
15.91	2.19	81.90	0.84	21.23	77.93
13.80	2.98	83.22	0.34	23.55	76.11

SOLUBILITY OF POTASSIUM FLUORIDE IN AQUEOUS SOLUTIONS OF ISO PROPYL ALCOHOL AT 25°.

(Ginnings and Chen, 1931.)

The results locate the binodal curve of the system, including a tie line, °, which shows the composition of two liquid layers in contact with each other and, the plait, PP, at which the two liquid layers become homogeneous.

Gms. per 100 gms. sat. sol.		Gms. per 100 gms. sat. sol.	
1. C ₃ H ₇ OH	KF	1. C ₃ H ₇ OH	KF
0.16	46.75	23.40	6.40
2.20	25.00	36.80	4.3 PP
4.45	18.68	39.20	4.0
7.70	14.30	65.80	1.0 °
15.10	9.30		

SOLUBILITY OF POTASSIUM FLUORIDE IN AQUEOUS SOLUTIONS OF
TERTIARY BUTYL ALCOHOL AT 30°.
(Ginnings and Robbins, 1930.)

The points on the binodal curve of this system were determined by observing the appearance or disappearance of clouding in a mixture of weighed amounts of KF and one of the liquids, upon addition of a weighed amount of the other. Conjugate points representing the lines * located by determining KF in two liquid layers in contact with each other. The plait point, PP, was found by plotting.

Gms. per 100 gms. sat. sol. (CH ₃) ₃ COH		Gms. per 100 gms. sat. sol. (CH ₃) ₃ COH		Gms. per 100 gms. sat. sol. (CH ₃) ₃ COH	
	KF		KF		KF
0.2	51.9	8.2	10.0	—	3.4*
0.7	29.8*	8.7	9.6	24.1	3.3
1.2	24.6	9.7	8.8	28.6	2.8
1.6	22.2	12.5	7.0	34.1	2.3
1.9	20.7	14.9	5.7	36.0	2.2PP
2.4	19.7	15.4	5.6	48.3	1.4
2.8	18.7	16.6	5.1	55.0	—*
3.8	16.9	17.7	4.5	60.0	—*
5.6	14.0	—	4.3*	60.6	0.8
6.3	12.7	—	4.1*	64.0	—*
7.7	10.9	20.4	3.7	99.0	—*

F

The binodal curve and plait point of the systems KF + (CH₃)₃COH + H₂O at 25° and of KF + Pyridine + H₂O at 25° have been determined respectively by Ginnings, Herring and Webb, 1933 and Ginnings, Webb and Hinohara, 1933, but the authors do not give their experimental results but only the values of a series of arbitrary constants calculated from them by means of empirical equations.

EQUILIBRIUM IN THE SYSTEM POTASSIUM FLUORIDE, NICKEL
FLUORIDE AND WATER.

(Kurtzacker, Fieger and Hey, 1933.)

Results at 20°

Gms. per 100 gms. sat. sol.		Solid Phase
NiF ₂	KF	
1.98	1.21	MC
1.20	3.52	"
0.80	6.32	"
0.52	9.64	"
0.40	12.9	"
0.01	16.8	"
—	20.2	"
—	25.5	"
—	28.1	"
—	33.0	"
—	37.5	"

Results at 50°

Gms. per 100 gms. sat. sol.		Solid Phase
NiF ₂	KF	
2.01	1.18	MC
1.12	4.30	"
0.26	9.25	"
0.04	15.4	"
0.01	19.2	"
—	22.1	"
—	25.0	"
—	27.7	"
—	31.3	"
—	36.3	"
—	41.3	"

MC = A series of mixed crystals (solid solutions) varying in composition from 0.8 to 1.4 mols. KF per 1 mol. of NiF₂.

POTASSIUM Hafnium FLUORIDE K_2HfF_6

100 gms. sat. solution of Potassium Hafnium Fluoride in Water contain 3.0 gms. K_2HfF_6 at 20°. (v. Hevesy, 1923.)

POTASSIUM Niobium FLUORIDE K_2NbF_7 **SOLUBILITY IN WATER AND IN AQUEOUS HF AND AQUEOUS KF SOLUTIONS.**
(Ruff and Schiller, 1911.)

The determinations were made in platinum vessels. The mixtures were shaken for 3 hour periods at constant temperature and the saturated solutions filtered through platinum funnels.

Solvent.	t°.	Gms. per 100 Gms. Sat. Solution.			Solid Phase.
		NbF_5 .	KF.	HF.	
Water	16	5.19	2.98	0.35	$K_2NbOF_5 \cdot H_2O$
"	16	7.07	5.33	4.35	$K_2NbOF_5 \cdot H_2O + K_2NbF_7$
Aq. 10.95% HF	16	4.33	2.32	10.43	K_2NbF_7
" 7.41% KF	16	1.16	5.54	0.13	$K_2NbOF_5 \cdot H_2O$
" 7.39% KF	16	2.67	6.04	5.39	$K_2NbOF_5 \cdot H_2O + K_2NbF_7$
Water	85	30.39	14.68	0.35	$K_2NbOF_5 \cdot H_2O(?)$
Aq. 4.81% KF	80	11.66	10.08	1.53	"

F

POTASSIUM Phospho FLUORIDE KPF_6

One liter sat. solution of Potassium Phospho Fluoride in Water contain 0.432 gm. mols. KPF_6 at 22.5°. (Lange and Müller, 1930.)

POTASSIUM GERMANIUM FLUORIDE K_2GeF_6 **SOLUBILITY IN WATER.**
(Winkler, 1887; Kruss and Nilson, 1887.)

100 gms. H_2O dissolve 173.98 gms. K_2GeF_6 at 18°, and 34.07 gms. at 100° (W.).
100 gms. H_2O dissolve 184.61 gms. K_2GeF_6 at 18°, and 38.76 gms. at 100° (K. and N.).

POTASSIUM Silico FLUORIDE K_2SiF_6 SOLUBILITY OF POTASSIUM SILICO FLUORIDE IN WATER AND
IN AQUEOUS AND ALCOHOLIC SOLUTIONS.

(Wassilieff and Martensoff, 1935.)

The determinations were made at room temperature, about 17°. The mixtures were frequently shaken during several hours and then allowed to stand over night. The dissolved K_2SiF_6 was determined by titration with 0.1 n NaOH using phenolphthaleine as indicator, bringing the solution nearly to the boiling point at the end of the titration.

Solvent	Gms. K_2SiF_6 per 100cc sat. sol.	Solvent	Gms. K_2SiF_6 per 100cc sat. sol.
Water	0.1147	2.0 gm. KCl per 100cc	
Aq. 50 Wt. % C_2H_5OH	0.0039	Aq. 50% C_2H_5OH	0.0022
Aq. Sat. KNO_3 Solution	0.0048	The above + 0.5cc	
Aq. Sat. KCl Solution	0.0048	0.1 n HCl	0.0020

F SOLUBILITY OF POTASSIUM SILICO FLUORIDE IN WATER.
(Carter, 1930.)

The mixtures were agitated mechanically for one hour and allowed to stand 24 hours at constant temperature. The solutions were analyzed volumetrically.

t°	Gms. K_2SiF_6 per 100cc sat. sol.	t°	Gms. K_2SiF_6 per 100cc sat. sol.
0	0.077	45	0.268
16	0.132	55	0.322
25	0.177	70	0.420
35	0.246	78	0.462
		88	0.500

SOLUBILITY OF POTASSIUM SILICO FLUORIDE IN AQUEOUS
SOLUTIONS OF ETHYL ALCOHOL AT 14°.

(Pierrat, 1921.)

Wt. Percent C_2H_5OH in Solvent	Gms. K_2SiF_6 per liter sat. sol.	Wt. Percent C_2H_5OH in Solvent	Gms. K_2SiF_6 per liter sat. sol.
0.0	0.9	27.3	0.09
8.7	0.46	42.4	0.05
15.9	0.21	64.7	0.0096

POTASSIUM Tantalum Fluoride K_2TaF_7

SOLUBILITY OF POTASSIUM TANTALUM FLUORIDE IN
AQUEOUS SOLUTIONS OF HYDROFLUORIC ACID.

(Babaeva and Klatchko-Gourvitch, 1935.)

Results at 0°			Results at 20°			Results at 80°		
Gms. per 100 gas. sat. sol.		Solid Phase	Gms. per 100 gas. sat. sol.		Solid Phase	Gms. per 100 gas. sat. sol.		Solid Phase
H ₂ F ₂	K ₂ TaF ₇		H ₂ F ₂	K ₂ TaF ₇		H ₂ F ₂	K ₂ TaF ₇	
0.105	0.114	K ₂ TaF ₇ + X	0.214	0.226	K ₂ TaF ₇ + X	2.170	3.367	K ₂ TaF ₇
0.610	0.246	K ₂ TaF ₇	0.288	0.319	K ₂ TaF ₇	5.023	3.843	"
1.757	0.287	"	1.520	0.620	"	7.550	4.305	"
3.750	0.364	"	4.234	0.783	"	10.230	4.863	"
6.545	0.454	"	9.859	1.015	"	16.690	6.331	"
11.207	0.579	"	16.520	1.440	"	24.233	8.820	"
17.273	0.815	"	19.047	1.609	"	32.610	11.444	"
24.099	1.326	"	25.420	2.368	"			
38.366	4.500	"	32.025	3.825	"			
			38.157	6.345	"			

POTASSIUM Thorium FLUORIDE $K_2ThF_6 \cdot H_2O$.

100 gms. sat. solution of Potassium Thorium Fluoride in Water contain 0.000064 gm. K_2ThF_6 at 25°. (Spicín, 1917.)

POTASSIUM Titanium **FLUORIDE** $K_2TiF_6 \cdot H_2O$.

SOLUBILITY OF POTASSIUM TITANIUM FLUORIDE IN WATER.

(Marignac, 1866.)

t°	0°	7°	10°	14°	20°	
Gms. K_2TiF_6 per 100 gms. H_2O	0.55	0.67	0.77	0.91	1.04	1.28

SOLUBILITY OF POTASSIUM TITANIUM FLUORIDE IN
WATER AND IN 98 PERCENT ETHYL ALCOHOL.

(Minsberg, 1032.)

Results for Water			Results for 98% C ₂ H ₅ OH		
t°	Gms. K ₂ TiF ₆ per 100cc sat. sol.	Solid Phase	t°	Gms. K ₂ TiF ₆ per 100cc sat. sol.	Solid Phase
20-22	1.3	K ₂ TiF ₆ · H ₂ O	20-22	0.005	K ₂ TiF ₆ · H ₂ O
"	1.2	K ₂ TiF ₆	"	0.0045	"

POTASSIUM ZIRCONOFLUORIDE K_2ZrF_6 (See also Zirconium salts.)

SOLUBILITY OF POTASSIUM ZIRCONO FLUORIDE IN WATER. (Missenden, 1922.)

No information is given as to how the determinations were made and no explanation of the column heading « No of parts of water ». Presumably this is the grams of water required to dissolve one gram of the salt.

t°.	No of parts water.	t°.	No of parts water.	t°.	No of parts water.
10....	81.75	40....	42.25	80....	14.50
20....	64.50	50....	34.00	90....	9.00
30....	52.00	60....	26.25	100....	4.25
		70....	19.75		

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100 gms. sat. solution of Potassium Zirconium Fluoride in Water contain 2.6 gm. K_2ZrF_6 at 20°. (v. Hevesy, 1923.)

Fusion-point data are given for the following mixtures:

$KF + KOH$ (Scarpa, 1915.) $KF + K_3PO_4$ (Amadori, 1912.)
 $" + KPO_3$ (Amadori, 1912.) $" + K_2SO_4$ (Karandeef, 1909.)
 $" + K_4P_2O_7$ " " " $+ NaF$ (Kurnakow & Zemcznzy, 1907.)

POTASSIUM IODIDE KI.

SOLUBILITY IN WATER.

(Mulder; de Coppet, 1883; Etard, 1894; Meusser, 1905; see also Tilden and Shenstone, 1884; Schreinemakers, 1892.)

t°.	Gms. KI per 100 Gms.		t°.	Gms. KI per 100 Gms.	
	Water.	Solution.		Water.	Solution.
-10	115.1	53.5	80	192	65.8
-5	119.8	54.5	90	200	66.7
-1	122.2	55.0	100	208	67.5
0	127.5	56.0	110	215	68.3
10	136	57.6	120	223	69.0
20	144	59.0	Ice Curve		
25	148	59.7			
30	152	60.3	-5	25.7	22.5
40	160	61.5	-7	42.6	29.9
50	168	62.7	-9.5	51.5	34.0
60	176	63.7	-11.5	64.7	39.3
70	184	64.8	-14	75.8	42.7

Sp. Gr. of sat. solution at 15.2° = 1.704.

(Greenish and Smith, 1901.)

Individual determinations, in good agreement with the above results, are given by van Dam and Donk (1911), and by Greenish and Smith (1901).

SOLUBILITY OF POTASSIUM IODIDE IN WATER.

The very closely agreeing results of Scott and Frazier, 1927; Scott and Frazier, 1927; Scott and Durham 1930; Hill, Willson and Bishop, 1933; and Hering, 1936; were plotted and the following values taken from the curve.

t°	d. of sat. sol.	Gms. KI per 100 gms. sat. sol.	t°	d. of sat. sol.	Gms. KI per 100 gms. sat. sol.
0	1.6673	56.1	50	1.7600	62.85
10	—	57.7	60	1.773	63.8
20	1.7160	59.1	70	—	64.8
25	1.7211	59.8	80	1.795	65.65
30	—	60.5	90	—	66.5
40	1.747	61.75	100	1.819	67.35

SOLUBILITY OF POTASSIUM IODIDE IN WATER AT TEMPERATURES ABOVE 100° DETERMINED BY THE SYNTHETIC METHOD.

(Kracek, 1931; Benrath, Gjeddebo, Schiffera and Wunderlich, 1937.)

t°	Gms. KI per 100 gms. H ₂ O	t°	Gms. KI per 100 gms. H ₂ O	t°	Gms. KI per 100 gms. H ₂ O	t°	Gms. KI per 100 gms. H ₂ O
100	206.4	150	246.7	200	292.9	275	376
110	214.3	160	255.0	210	303.4	300	525
120	222.3	170	263.7	220	314.3	350	558
130	230.3	180	272.9	230	326.0	400	614
140	238.5	190	282.6	240	338.4	450	809

SOLUBILITY OF POTASSIUM IODIDE IN WATER, DETERMINED
BY THE FREEZING-POINT METHOD.
(Kremann and Kerschbaum, 1907.)

t°.	Gms. KI per 100 Gms. Sat. Sol.	Solid Phase.	t°.	Gms. KI per 100 Gms. Sat. Sol.	Solid Phase.
-12.5	38	Ice	-22.5	52.1	KI
-15	41.2	"	-20	52.6	"
-17.5	44.6	"	-15	53.5	"
-20	48	"	-10	54.5	"
-22.5	51.2	"	-5	55.4	"
-23.2 Eutec.	51.9	" + KI	0	56.4	"

SOLUBILITY OF POTASSIUM IODIDE + IODINE IN WATER AT 25°.
(Foote and Chalker, 1908.)

Gms. per 100 Gms. Sat. Sol.			Present in Solid Phase.	Gms. per 100 Gms. Sat. Sol.			Present in Solid Phase.
KI.	I.	I - KI.		KI.	I.	I - KI.	
29.45	64.34	34.89	KI and KI ₃	25.88	68.79	42.91	KI ₃ and Iodine
28.91	63.88	34.97		25.57	69.01	43.44	
26.84	66.54	39.70	KI ₃ and KI ₇	27.86	66.56		KI ₃
27.18	67.14	39.96		27.27	66.91		
27.14	66.60	39.46		26.95	67.17		
				25.71	67.91		KI ₇

The experiments of Hamberger (1906) are discussed.

I

For other data upon polyiodides see Iodine

SOLUBILITY OF MIXTURES OF POTASSIUM IODIDE AND SILVER IODIDE IN
WATER AT 0°, 30° AND 50°.
(Van Dam and Donk, 1911.)

Results at 0°.		Results at 30°.		Results at 50°.		Solid Phase in Each Case.
Gms. per 100	Gms. Sat. Sol.	Gms. per 100	Gms. Sat. Sol.	Gms. per 100	Gms. Sat. Sol.	
AgI.	KI.	AgI.	KI.	AgI.	KI.	
0	56.1	0	60.35	0	62.6	KI
9	53	16	55.5	10.7	59.1	"
18	51.2	35.8	46.9	22.8	55.5	"
31.3	46.6	42.8	43.9	45	43.2	"
37.9	44	44.1	43.2	53.4	37.6	" + AgI.KI
37.6	42.7	47.7	40.9	53.5	37.1	AgI.KI
38	41.3	49.7	38.6	53.5	36.6	" + AgI
28.1	36.4	42.8	38.8	53.5	36.5	AgI
26.6	34.6	29.4	37.6	39	38.1	"
6.5	26.1	10	31.4	28	36.7	"
1.5	20.5	16	33.8	"
0.2	9.8	0.1	10.2	2.5	24.8	"
27.5	48.7	AgI.KI + KI
21	50.3	AgI ₂ KI

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SOLUBILITY OF POTASSIUM IODIDE IN AQUEOUS SOLUTIONS OF
POTASSIUM IODATE AT 25° AND VICE VERSA.

(Ricci, 1907.)

d. of sat. sol.	Gms. per 100 gms. sat. sol.		Solid Phase	d. of sat. sol.	Gms. per 100 gms. sat. sol.		Solid Phase
	KIO ₃	KI			KIO ₃	KI	
1.718	0.0	59.76	KI	1.451	2.54	41.10	KIO ₃
1.731	1.10	59.14	"	1.227	3.27	22.38	"
—	2.25	58.62	"	—	4.33	12.04	"
1.751	2.35	58.51	" + KIO ₃	1.053	7.15	2.40	"
1.722	2.35	57.02	KIO ₃	1.071	8.449	0.0	"

SOLUBILITY OF POTASSIUM IODIDE IN AQUEOUS SOLUTIONS OF
POTASSIUM HYDROXIDE AT 20°.

(Brönsted, 1920(a).)

Gm. Moles. per liter sat. sol.		Gm. Moles. per liter sat. sol.	
KOH	KI	KOH	KI
9.41	1.72	12.72	0.824
10.95	1.23	14.02	0.672
11.10	1.176	15.01	0.558
12.19	0.933		

SOLUBILITY OF POTASSIUM IODIDE IN AQUEOUS SOLUTIONS OF
POTASSIUM SULFATE AT 25° AND VICE VERSA.

(Ricci, 1936.)

d. of sat. sol.	Gms. per 100 gms. sat. sol.		Solid Phase	d. of sat. sol.	Gms. per 100 gms. sat. sol.		Solid Phase
	K ₂ SO ₄	KI			K ₂ SO ₄	KI	
1.718	0.0	59.76	KI	1.273	1.70	28.81	K ₂ SO ₄
1.722	0.08	59.60	" + K ₂ SO ₄	1.185	4.57	18.57	"
1.701	0.10	58.70	K ₂ SO ₄	1.127	6.57	9.13	"
1.399	0.69	39.57	"	1.083	10.76	0.0	"

SOLUBILITY OF POTASSIUM IODIDE IN AQUEOUS SOLUTIONS OF
SODIUM IODIDE AND VICE VERSA.

(Hill, Willson and Bishop, 1933.)

t°	Gms. per 100 gms. sat. sol.		Solid Phase	t°	Gms. per 100 gms. sat. sol.		Solid Phase
	KI	NaI			KI	NaI	
8	57.33	0.0	KI	25	7.59	59.35	KI + NaI.2H ₂ O
"	37.54	19.97	"	"	7.06	59.71	NaI.2H ₂ O
"	19.20	40.55	"	"	6.80	59.97	"
"	8.36	55.58	"	"	5.44	60.74	"
"	7.44	57.13	" + NaI.2H ₂ O	"	4.78	61.35	"
"	5.82	58.23	NaI.2H ₂ O	"	2.17	63.15	"
"	0.0	62.49	"	"	0.0	64.72	"
25	59.78	0.0	KI	40	61.73	0.0	KI
"	50.32	9.29	"	"	48.04	13.47	"
"	42.08	17.60	"	"	35.55	26.20	"
"	29.79	30.55	"	"	21.33	42.04	"
"	21.43	40.11	"	"	9.68	57.85	"
"	15.90	46.91	"	"	7.23	62.34	" + NaI.2H ₂ O
"	10.60	54.49	"	"	4.81	63.92	NaI.2H ₂ O
				"	0.0	67.35	"

SOLUBILITY OF POTASSIUM IODIDE IN AQUEOUS SOLUTIONS OF
LEAD IODIDE AND VICE VERSA.

Results at 13°. (Demassieux, 1923.)		Results at 25°. (Burrage, 1926.)		Results at 50°. (Demassieux, 1923.)		Solid Phase. of each temperature.
Gms. per 100 gms. sat. sol.		Gms. per 100 gms. sat. sol.		Gms. per 100 gms. sat. sol.		
KI.	PbI ₂ .	KI.	PbI ₂ .	KI.	PbI ₂ .	PbI ₂
0.0	0.05	0.083	0.0234	2.84	0.002	"
2.21	0.001	0.166	0.0092	9.33	0.02	"
4.18	0.001	0.332	0.0040	14.48	0.02	"
9.09	0.002	0.664	0.0020	17.36	0.12	"
"	"	0.830	0.0019	18.77	0.14	"
"	"	1.661	0.0016	19.50	0.15	"
"	"	3.320	0.0020	21.00	0.27	"
"	"	8.307	0.0073	29.43	1.74	"
"	"	13.61	0.0316	29.51	1.82	"
"	"	14.90	0.0578	30.47	2.45	"
"	"	19.45	0.253	30.57	2.52	"
6.02	0.05	21.32	0.428	31.77	3.11	" + PbI ₂ .KI.2H ₂ O
7.26	0.02	26.82	0.553	32.12	3.10	PbI ₂ .KI.2H ₂ O
1.32	0.19	36.73	1.221	36.18	3.99	"
4.45	0.68	43.80	2.249	38.44	4.23	"
7.25	0.77	49.43	3.712	42.28	5.64	"
5.17	1.47	51.61	4.654	51.93	9.59	"
2.14	2.91	54.60	5.876	53.96	11.74	"
6.55	4.54	56.59	7.421	56.41	14.14	" + KI
7.66	0.0	57.82	5.235	58.49	9.72	KI
		59.13	5.49	60.28	5.55	"
		59.72	0.00	61.98	1.52	"
				62.02	1.48	"
				62.39	0.0	"

In the case of the determinations by Burrage, constant agitation in a thermostat was employed. At low concentration of PbI₂ the lead was determined colorimetrically. For the determinations by Demassieux the solutions were simply shaken by hand several times a day and the temperature held constant to within 0°5.

See also PbI₂; Lead Iodide, for additional data on this system.

SOLUBILITY OF POTASSIUM IODIDE IN AQUEOUS SOLUTIONS
OF METHYL ALCOHOL AT 25°.
(Akerlöf and Turck, 1935.)

Wt. % CH ₃ OH in Solvent	Gm. Mols. KI per 1000 gms. Solvent	Wt. % CH ₃ OH in Solvent	Gm. Mols. KI per 1000 gms. Solvent	Wt. % CH ₃ OH in Solvent	Gm. Mols. KI per 1000 gms. Solvent
0.0	8.962	60.21	3.333	89.79	1.412
20.0	6.776	72.39	2.473	94.76	1.187
40.82	4.845	80.03	1.970	100.00	0.965

SOLUBILITY OF POTASSIUM IODIDE IN AQUEOUS SOLUTIONS OF
LEAD IODIDE AND VICE VERSA.
(Van Klooster and Balon, 1934.)

Results at 0°

Gms. per 100 gms. sat. sol.		Solid Phase
KI	PbI ₂	
56.07	0.0	KI
55.65	1.23	"
55.28	2.00	"
55.10	3.10	" + $\text{KPbI}_3 \cdot 2\text{H}_2\text{O}$
53.10	2.41	$\text{KPbI}_3 \cdot 2\text{H}_2\text{O}$
46.20	1.30	"
40.56	0.724	"
35.20	0.445	"
29.72	0.263	"
25.56	0.146	"
19.60	0.074	"
15.26	0.044	"
11.42	0.037	" + PbI ₂
10.35	0.030	PbI ₂
7.26	0.012	"
4.55	0.002	"
2.21	0.001	"
0.166	0.003	"
0.0	0.043	"

Results at 25°

Gms. per 100 gms. sat. sol.		Solid Phase
KI	PbI ₂	
59.77	0.0	KI
58.53	2.267	"
58.40	3.663	"
57.75	5.22	"
56.60	7.30	" + $\text{KPbI}_3 \cdot 2\text{H}_2\text{O}$
55.75	5.901	$\text{KPbI}_3 \cdot 2\text{H}_2\text{O}$
51.42	4.491	"
43.48	2.348	"
38.38	1.537	"
30.77	0.801	"
21.29	0.422	" + PbI ₂
21.09	0.410	PbI ₂
21.03	0.408	"
19.58	0.256	"
12.52	0.033	"
9.97	0.020	"
0.645	0.001	"
0.159	0.010	"
0.00	0.075	"

EQUILIBRIUM IN THE SYSTEM POTASSIUM IODIDE, ANTIMONY IODIDE AND WATER.
(Francois, 1935; Francois and Delvaux, 1934.)

The authors give a diagram but no numerical results. The following approximate values for the triple points were estimated from the diagram.

Results at 16°

Gms. per 100 gms. H ₂ O	
KI	SbI ₃
195	105
160	125

Results at 32°

Gms. per 100 gms. H ₂ O	
KI	SbI ₃
220	130
200	155

Results at 48°

Gms. per 100 gms. H ₂ O	
KI	SbI ₃
245	155
218	200

Solid Phase at each temperature

KI + 2KI · SbI₃ · H₂O
SbI₃ + "

EQUILIBRIUM IN THE SYSTEM POTASSIUM IODIDE, CAFFEINE AND WATER.
(Chambon and Duron, 1937.)

Results at 2°

Results at 35°

Results at 90°

Gms. per 100 gms. H ₂ O		Gms. per 100 gms. H ₂ O		Gms. per 100 gms. H ₂ O		Solid phase at each temperature
Caffeine(anhyd)	KI	Caffeine(anhyd)	KI	Caffeine(anhyd)	KI	
0.735	0.0	3.52	0.0	83.5	0.0	Caffeine
—	—	—	—	70.2	5.0	"
—	—	—	—	41.0	167.0	"
18.2	133.1	25.0	156.0	43.0	199.0	" + KI
0.0	130.1	0.0	156.0	0.0	196.6	KI

SOLUBILITY OF POTASSIUM IODIDE IN AQUEOUS SOLUTIONS OF ETHYL
AND OF METHYL ALCOHOL. (Zeitlin, 1926.) See last table p. 1361.

Solvent.	Gm. mols. KI dissolved per liter at		Solvent.	Gm. mols. KI dissolved per liter at	
	10°.2.	19°.9.		10°.2.	19°.9.
Water.....	5.863	6.110	Aq. 25.96 wt. % $\text{C}_2\text{H}_5\text{OH}$.	4.169	4.308
25.07 wt. % $\text{C}_2\text{H}_5\text{OH}$.	3.970	4.083	" 45.13 "	3.089	3.25
50.01 " "	2.419	2.612	" 74.88 "	1.632	1.693
75.03 " "	1.120	1.142	100.00 " "	0.7519	0.7350
97.30 " "	-	0.0428			
5 gms. glycerol of $d = 1.2326$ ($= 86.5\%$)	dissolve 58.3 gms. KI at 20°.				
" " " $d = 1.2645$ ($= 98.5\%$)	" 50.6 " " "				

(Holm, 1921, 1921 a, 1922.)

SOLUBILITY OF POTASSIUM IODIDE IN AQUEOUS SOLUTIONS OF METHYL ALCOHOL

AT 25°.

(Herz and Anders, 1907.)

Solvent.		Sat. Solution.		Solvent.		Sat. Solution.	
d_{25}°	Wt. Per cent CH_3OH	d_{25}°	Gms. KI per 100 cc.	d_{25}°	Wt. Per cent CH_3OH	d_{25}°	Gms. KI per 100 cc.
0.9971	0	1.7213	102.9	0.8820	64	1.185	40.33
0.9791	10.6	1.634	92.12	0.8489	78.1	1.066	28.05
0.9481	30.8	1.460	71.55	0.8167	93.9	0.9700	18.76
0.9180	47.1	1.325	55.6	0.7881	100	0.9018	13.28

SOLUBILITY OF POTASSIUM IODIDE IN SEVERAL ALCOHOLS.

Alcohol.	t°.	Gms. KI per 100 Gms. Alcohol.	Authority.
Methyl Alcohol	11.4	13.5	(Timofeiew, 1894.)
" "	12.2	14.6	"
" "	13.5	16	"
" "	25	18.04	(Turner and Bissett, 1913.)
Ethyl	13.6	1.63	(Timofeiew, 1894.)
" "	25	2.16	(Turner and Bissett, 1913.)
Propyl	12.2	0.731	(Timofeiew, 1894.)
" "	25	0.43	(Turner and Bissett, 1913.)
Amyl	25	0.098	" "

100 cc. sat. solution of KI in ethyl alcohol contain 1.585 gms. KI at 25°.

(Laurie, 1912.)

SOLUBILITY OF POTASSIUM IODIDE IN SEVERAL ALCOHOLS AT 25°.

(Larson and Hunt, 1939.)

Alcohol	Formula	d. of sat. sol.	Gms. KI per 100 gms. solvent
Methanol	CH_3OH	0.8982	17.04
Ethanol	$\text{C}_2\text{H}_5\text{OH}$	0.7977	1.88
Propanol	$\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$	0.8035	0.444
Butanol (n)	$\text{CH}_3(\text{CH}_2)_2\text{CH}_2\text{OH}$	0.8071	0.201
Propanol (iso)	$\text{CH}_3\text{CHOHCH}_3$	0.7821	0.177
Methyl-1-propanol	$(\text{CH}_3)_2\text{CHCH}_2\text{OH}$	0.7986	0.0955
Pentanol	$\text{CH}_3(\text{CH}_2)_3\text{CH}_2\text{OH}$	0.8112	0.0894
Butanol (sec)	$\text{CH}_3\text{CH}_2\text{CHOHCH}_3$	0.8026	0.0582

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SOLUBILITY OF POTASSIUM IODIDE IN DILUTE AQUEOUS SOLUTIONS OF ETHYL ALCOHOL AT 25°.

(Armstrong, Eyre, Hussey, and Paddison, 1907.)

Wt. Per cent C_2H_5OH in Solvent.	d_{25}^{20} of Sat. Sol.	Gms. KI per 100 Gms. Sat. Sol.	Wt. Per cent C_2H_5OH in Solvent.	d_{25}^{20} of Sat. Sol.	Gms. KI per 100 Gms. Sat. Sol.
0	1.7268	59.80	4.41	1.6833	58.08
1.14	1.7154	59.41	12.14	1.6063	54.93
2.25	1.7042	58.95	18.73	1.5420	52.08

100 gms. aqueous 94% ethyl alcohol dissolve 3.99 gms. KI at 17°. (de Bruyn, 1892.)

100 gms. aqueous 98% methyl alcohol dissolve 17.1 gms. KI at 17°.

100 cc. of ethyl alcohol of $d_{15} = 0.8292$ dissolve 8.83 gms. KI at 15°, d_{15} of sat. solution = 0.8989. (Greenish and Smith, 1901.)

SOLUBILITY OF POTASSIUM IODIDE IN ABSOLUTE ALCOHOLS.

(de Bruyn — Z. physik. Ch. 10, 783, '02; Kohland — Z. anorg. Ch. 18, 327, '98.)

100 gms. methyl alcohol dissolve 16.5 gms. KI at 20.5°.

100 gms. ethyl alcohol dissolve 1.75 gms. KI at 20.5°.

100 gms. propyl alcohol dissolve 0.46 gm. KI at 15°–20° (R.).

SOLUBILITY OF POTASSIUM IODIDE IN:

Ethyl Alcohol

Aqueous Ethyl Alcohol at 18°.

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of 0.9496 Sp. Gr.

t°.	Gms. KI per 100 Gms. Alcohol	Sp. Gr. of Alcohol.	Weight per cent Alcohol.	Gms. KI per 100 Gms. Alcohol.	Sp. Gr. of Alcohol.	Weight per cent Alcohol.	Gms. KI per 100 Gms. Alcohol.
8	67.4	0.9904	5.2	130.5	0.9390	45	66.4
13	69.2	0.9851	9.8	119.4	0.9088	59	48.2
25	75.1	0.9726	23.0	100.1	0.8464	86	11.4
46	84.7	0.9665	29.0	89.9	0.8322	91	6.2
55	87.5	0.9528	38.0	76.9			
62	90.2						

(Gerardin — Ann. chim. phys. [4] 5, 155, '65.)

SOLUBILITY OF POTASSIUM IODIDE IN ABSOLUTE ETHYL ALCOHOL SOLUTIONS OF SODIUM IODIDE AND OF MAGNESIUM IODIDE AT 25°.

(Hawkins and Partington, 1928, 1930.)

The density of the absolute C_2H_5OH was $d_{25}^{25} = 0.7851$. The sat. solutions were prepared in an atmosphere of hydrogen.Results for C_2H_5OH
Solutions of NaIResults for C_2H_5OH
Solutions of MgI_2

d. of sat. sol.	Gms. per 100 gms. C_2H_5OH NaI	Gms. per 100 gms. C_2H_5OH KI
0.7970	0.0	1.824
0.8215	4.248	1.268
0.8378	7.091	0.9988
0.8502	9.065	0.8878
0.8921	15.84	0.6752
0.9614	27.68	0.442
1.0500	42.8	0.19

d. of sat. sol.	Gms. per 100 gms. C_2H_5OH MgI_2	Gms. per 100 gms. C_2H_5OH KI
0.8161	2.777	1.502
0.8202	3.20	1.513
0.8317	5.33	1.578
0.8420	6.017	1.560
0.8634	8.809	1.393
0.9037	14.41	1.195
0.9182	17.82	1.116
0.9314	18.04	0.00

SOLUBILITY OF POTASSIUM IODIDE IN LIQUID METHYL ALCOHOL AT TEMPERATURES UP TO THE CRITICAL POINT.

(Tyrer, 1910.)

(Determined by the Sealed Tube Method.)

t°.	Gms. KI per 100 Gms. CH ₃ OH.	t°.	Gms. KI per 100 Gms. CH ₃ OH.	t°.	Gms. KI per 100 Gms. CH ₃ OH.
15	14.50	120	27.2	220	27.5
30	16.20	140	29.2	240	24.8
50	18.9	160	30.6	245	22.6
80	22.5	180	30.7	247	21
100	25	200	29.1	250	13.8
			crit. temp.	252.5	7.6

SOLUBILITY OF POTASSIUM IODIDE IN VAPOR OF METHYL ALCOHOL ABOVE THE CRITICAL POINT.

(Tyrer, 1910a.)

Solvent, Gms. CH ₃ OH per 1 cc. Vapor.	Gms. KI Dissolved per 100 Gms. Solvent at:				
	252°.	270°.	280°.	290°.	300°.
0.1	0.3	...	...	...	...
0.2	1	1	1	1	1
0.3	3.7	3.5	3.4	3.4	3.3
0.36	7.6	7.4	7.3	7.2	7.
0.4	11.8	11.5	11.3	11	...
0.45	18.1	...	...	...	...

Data for the above system are also given by Centnerszwer (1910). This author gives the crit. temp. as 266° and the corresponding concentration as 8.64 gms. KI per 100 gms. of the sat. solution.

SOLUBILITY OF POTASSIUM IODIDE IN MIXTURES OF ALCOHOLS AT 25°.

(Herz and Kuhn, 1908.)

In Methyl + Ethyl Alcohol.			In Methyl + Propyl Alcohol.			In Ethyl + Propyl Alcohol.		
Per cent CH ₃ OH in Solvent.	d ₄ ²⁵ of Sat. Sol.	Gms. KI per 100 cc. Sat. Sol.	Per cent C ₂ H ₅ OH in Solvent.	d ₄ ²⁵ of Sat. Sol.	Gms. KI per 100 cc. Sat. Sol.	Per cent C ₂ H ₅ OH in Solvent.	d ₄ ²⁵ of Sat. Sol.	Gms. KI per 100 cc. Sat. Sol.
0	0.8015	1.55	0	0.9018	13.16	0	0.8015	1.55
4.37	0.8041	1.91	11.11	0.8823	10.06	8.1	0.7983	1.46
10.4	0.8071	2.25	23.8	0.8629	8.54	17.85	0.7991	1.37
41.02	0.8295	4.94	65.2	0.8187	2.62	56.6	0.7988	0.75
80.69	0.8794	10.13	91.8	0.8045	0.60	88.6	0.8022	0.52
84.77	0.8795	10.72	96.6	0.8041	0.58	91.2	0.8027	0.49
91.25	0.8908	11.84	100	0.8041	0.43	95.2	0.8029	0.44
100	0.9018	13.16				100	0.8041	0.43

SOLUBILITY OF POTASSIUM IODIDE IN ACETAMIDE.

(Menschutkin, 1908.)

(Determinations by Synthetic Method.)

t°.	Gms. KI per 100 Gms. Sat. Sol.	Solid Phase.	t°.	Gms. KI per 100 Gms. Sat. Sol.	Solid Phase
82 m. pt.	0	CH ₃ CONH ₂	70	28.75	KI
78	6.5	"	85	29.1	"
74	12.8	"	100	29.45	"
70	17.8	"	130	30.15	"
66	21.5	"	145	30.5	"
58	26.2	"	160	30.8	"
53 Eutec.	28.4	" + KI	175	31.1	"

SOLUBILITY OF POTASSIUM IODIDE IN ACETONE AND IN PYRIDINE.

(von Laszczynski, 1894; at 25°, Krug and McElroy, 1892.)

Solvent.	Gms. KI per 100 Gms. Solvent at:					
	-2.5°	10°	22°	25°	56°	119°
Acetone	3.08	...	2.38	2.93	1.21	...
Pyridine	...	0.26	...	...	...	0.11

100 gms. glycerol dissolve 40 gms. KI at 15.5°. (Ossendowski, 1907.)

100 gms. 95% formic acid dissolve 38.2 gms. KI at 18.5°. (Aschan, 1913.)

100 cc. anhydrous hydrazine dissolve 175 gms. KI at room temp.

(Welsh and Broderson, 1915.)

100 gms. hydroxylamine dissolve 110 gms. KI at 17.5°. (de Bruyn, 1892.)

100 gms. sat. solution in hydrated lanolin (containing 30% emulsified water) contain 42.5 gms. KI at 45°. (Klose, 1907.) KI is insoluble in anhydrous lanolin.

SOLUBILITY OF POTASSIUM IODIDE IN SEVERAL SOLVENTS.

(Walden, 1906.)

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Solvent.	Formula.	t°.	Sp. Gr. of Solution.	Gms. KI per 100	
				cc. Solution	Gms. Solution.
Water	H ₂ O	0	1.6600	94.05	56.32
Water	H ₂ O	25	1.7254	102.70	59.54
Methyl Alcohol	CH ₃ OH	0	0.8064	11.61	12.05
Methyl Alcohol	CH ₃ OH	25	0.9003	13.5-14.3	14.07
Ethyl Alcohol	C ₂ H ₅ OH	0	0.8085	1.197	1.479
Ethyl Alcohol	C ₂ H ₅ OH	25	0.7908	1.520	1.022
Glycol	(CH ₂ OH) ₂	0	1.3954	45.85	31.03
Glycol	(CH ₂ OH) ₂	25	1.3888	47.23	33.01
Acetonitrile	CH ₃ CN	0	0.8198	1.852	2.259
Acetonitrile	CH ₃ CN	24	0.7938	1.57	2.003
Propionitrile	C ₂ H ₅ CN	0	0.8005	0.34-0.41	0.0420
Propionitrile	C ₂ H ₅ CN	25	0.7821	0.32-0.36	0.0404
Benzonitrile	C ₆ H ₅ CN	25	1.0076	0.051	0.0506
Nitromethane	CH ₃ NO ₂	0	1.1627	0.314-0.366	0.315
Nitromethane	CH ₃ NO ₂	25	1.1367	0.289-0.349	0.307
Nitrobenzene	C ₆ H ₅ NO ₂	25	...	0.0019	...
Acetone	(CH ₃) ₂ CO	0	0.8227	1.732	2.105
Acetone	(CH ₃) ₂ CO	25	0.7968	1.038	1.302
Furfurol	C ₄ H ₃ O.CO.H	0	...	15.10	...
Furfurol	C ₄ H ₃ O.CO.H	25	1.2014	5.62	4.94
Benzaldehyde	C ₆ H ₅ COH	25	1.0446	0.343	0.328
Salicylic Aldehyde	C ₆ H ₄ .OH.CO.H	0	1.1501	1.257	1.093
Salicylic Aldehyde	C ₆ H ₄ .OH.CO.H	25	1.1373	0.549	0.483
Anisic Aldehyde	C ₆ H ₄ .OCH ₃ .CO.H	0	1.1223	1.520	1.355
Anisic Aldehyde	C ₆ H ₄ .OCH ₃ .CO.H	25	1.1180	0.720	0.644
Ethyl Acetate	CH ₃ COOC ₂ H ₅	25	...	0.0013	...
Methyl Cyanacetate	CH ₃ CNCOOCH ₃	0	1.1521	3.256	2.827
Methyl Cyanacetate	CH ₃ CNCOOCH ₃	25	1.1358	2.459	2.165
Ethyl Cyanacetate	CH ₃ CNCOOC ₂ H ₅	25	1.0628	0.989	0.930

SOLUBILITY OF POTASSIUM IODIDE AT 20° IN SEVERAL SOLVENTS CONTAINING DISSOLVED IODINE.
(Olivari, 1908.)

Solvent.	Gm. Mols. KI per Liter in Solvent Containing:		
	0.5 Gm. Mols. I ₂ per Liter.	1.5 Gm. Mols. I ₂ per Liter.	2.5 Gm. Mols. I ₂ per Liter.
Acetic Acid	0.511	1.460	2.080
Ethyl Acetate	0.490	1.400	1.980
Ethyl Alcohol	0.520	1.220	1.730
Nitrobenzene	0.414	0.960	1.380
Ethylbromide	0.140	0.350	...

SOLUBILITY OF POTASSIUM IODIDE IN AQUEOUS SOLUTIONS OF ETHYLENE GLYCOL AT 30°.
(Ginnings and Robbins, 1930.)

d. of sat. sol.	Gms. per 100 CH ₂ OHCH ₂ OH	Gms. sat. sol. KI	d. of sat. sol.	Gms. per 100 CH ₂ OH·CH ₂ OH	Gms. sat. sol. KI
1.7302	0.0	60.31	1.5395	32.27	45.38
1.6655	8.96	55.90	1.4687	51.57	38.27
1.6031	19.26	50.98	1.4272	66.41	33.59

SOLUBILITY OF POTASSIUM IODIDE IN PURE ACETONE DETERMINED BY SPECIFIC CONDUCTIVITY MEASUREMENTS.
(Lannung, 1932.)

t°	d. of sat. sol.	Gms. KI per 1000 Gms. CH ₃ COCH ₃
18	0.799	11.19
37	0.77	8.02

EQUILIBRIUM IN THE SYSTEM POTASSIUM IODIDE, TERTIARY BUTYL ALCOHOL AND WATER AT 30°.
(Ginnings and Robbins, 1930.)

The points of the binodal curve of this system were determined by observing the appearance or disappearance of clouding in mixtures of weighed amounts of KI in one of the liquids upon addition of weighed amounts of the other. Tie lines, —, connecting conjugate points were located by determination of KI in liquid layers in contact with each other and from these the plait point, PP, was found by plotting.

Gms. per 100 (CH ₃) ₃ COH	Gms. sat. sol. KI	Gms. per 100 (CH ₃) ₃ COH	Gms. sat. sol. KI	Gms. per 100 (CH ₃) ₃ COH	Gms. sat. sol. KI
3.3	54.7*	17.9	39.6	45.0	—*
4.0	52.9	19.9	38.6	46.5	23.4
5.2	49.8	22.1	37.0	49.2	22.1
7.2	47.3	24.2	35.6	50.0	—*
—	47.1*	26.0	34.6 PP	52.0	20.9
8.4	46.1	27.6	33.4	57.7	18.5
9.6	45.4*	30.6	31.9	60.3	16.9
11.3	44.0	35.1	29.5	62.8	15.5
13.9	42.3	39.2	27.0	63.0	—
15.1	41.1	42.0	25.5		
16.6	40.3	44.3	24.6		

The composition of the plait point PP at 25° is 38.4 Gms. KI + 22.2 Gms. (CH₃)₃COH per 100 Gms. sat. solution. (Ginnings, Herring and Webb, 1933.)

DISTRIBUTION OF POTASSIUM IODIDE AT 17° BETWEEN WATER AND AMYL ALCOHOL.
(Wonnensensky, 1925.)

Millimols. KI per liter of		
H ₂ O layer (C ₁).	Alcohol layer (C ₂).	$\frac{C_1}{C_2}$
105.5	0.27	207
228.5	1.20	208
336.75	2.25	218
485.5	5.00	217

100 cc. sat. solution of potassium iodide in ethyl urethan contain 5.81 gms. KI at 60°. (Stuckgold, 1917.)

EQUILIBRIUM IN THE SYSTEM POTASSIUM IODIDE — ETHYL ETHER — WATER AT 20°. (Dunningham, 1914.)

Gms. per 100 Gms. Upper Layer.			Gms. per 100 Gms. Lower Layer.			Solid Phase.
KI.	H ₂ O.	(C ₂ H ₅) ₂ O.	KI.	H ₂ O.	(C ₂ H ₅) ₂ O.	
...	...	...	59.2	40.8	...	KI
0	3.9	96.1	0	93	7	None
0.4	0.4	99.2	55.6	40.7	3.7	KI
0.1	2.2	97.7	25	72.1	2.0	None

DISTRIBUTION OF POTASSIUM IODIDE BETWEEN WATER AND:

Nitrobenzene at 18°. (Dawson, 1908.)

Mols. KI per Liter.		Dist. Ratio.
C ₆ H ₅ NO ₂ Layer.	H ₂ O Layer.	
0.00114	6.05	5300
0.00108	6.05	5000

Phenol at Room Temp. (Riesenfeld, 1902.)

Gms. KI per 100 cc.		Dist. Ratio.
C ₆ H ₅ OH Layer.	Aq. Layer.	
0.052	0.725	13.2
0.197	2.42	12.3
2.00	30.7	14.7

SOLUBILITY OF POTASSIUM IODIDE IN PURE ALLYL ALCOHOL
SOLUTIONS OF SODIUM IODIDE AT 25°.

(Partington and Winterton, 1934.)

The density of the Allyl Alcohol, CH₂CHCH₂OH, was $d_{25}^{25} = 0.84572$.

d. of sat. sol.	Gms. per 100 gms. C ₃ H ₅ CH ₂ OH		d. of sat. sol.	Gms. per 100 gms. C ₃ H ₅ CH ₂ OH	
	NaI	KI		NaI	KI
0.85080	0.0	1.133	0.90753	8.164	0.745
0.86134	1.157	1.060	0.93501	12.501	0.565
0.87286	2.178	1.000	0.96453	17.520	0.390
0.88750	5.300	0.837	0.98624	23.252	0.200
0.88890	5.321	0.820	1.02685	28.48	0.0
0.90044	7.110	0.781			

SOLUBILITY OF POTASSIUM IODIDE IN PURE BENZYL ALCOHOL
SOLUTIONS OF SODIUM IODIDE AT 25°.

(Partington and Winterton, 1934.)

The density of the Benzyl alcohol, C₆H₅CH₂OH, was 1.0451.

d. of sat. sol.	Gms. per 100 gms. C ₆ H ₅ CH ₂ OH		d. of sat. sol.	Gms. per 100 gms. C ₆ H ₅ CH ₂ OH	
	NaI	KI		NaI	KI
1.04485	0.0	0.320	1.10612	5.613	0.271
1.05650	1.324	0.305	1.11923	7.267	0.263
1.06203	2.235	0.301	1.14585	11.010	0.197
1.10043	4.700	0.290	1.14633	14.400	0.000

SOLUBILITY OF POTASSIUM IODIDE IN AQUEOUS
SOLUTIONS OF URETHAN AT 25°.
(Palitzsch, 1928, 1929.)

Gm. Mols. per 1000 gms. H ₂ O		Solid Phase
NH ₂ COOC ₂ H ₅	KI	
0.0	9.0355	KI
1.1225	8.979	"
20.79	8.73	"
46.72	9.66	" + NH ₂ COOC ₂ H ₅
53.09	0.0	NH ₂ COOC ₂ H ₅

SOLUBILITY OF POTASSIUM IODIDE IN LIQUID AMMONIA.

t°	Gms. KI per 100 gms. NH ₃	Authority
0	184.2	(Linhard and Stephen, 1933, 1934.)
25	182.0	(Hunt, 1932.)

100 gms. Liquid Sulfur Dioxide dissolve 41.3 gms. KI at 0°. (Jander and Ruppolt, 1937.)

Data for equilibrium in the System KI + SO₂ are given by Walden and Centnerszwer, 1903. Results for the vapor pressure, temperature relations of the system are given by Foote and Fleischer, 1931.

Fusion point data have been determined for the following mixtures.

KI + K ₂ SO ₄	(Ruff and Plato, 1903.)
" + AgI	(Sandoninni, 1912a)
" + NaCl	(Ruff & Plato, 1903; Waxberg, 1930.)
" + PbI ₂	(van Klooster and Stearns, 1933.)
" + SO ₂	(Walden and Centnerszwer, 1903.)

POTASSIUM IODOMERCURATE (Thoulet Solution).

A sat. solution at 22.9°, prepared by adding KI and HgI₂ in excess to water, contained 8.66% K, 22.49% Hg, 52.58 (57.7) % I and 10.97 (11.15)% H₂O, corresponding to 0.22 mol. alkali, 0.11 mol. Hg and 0.45 mol. I. (Dubois, 1905.)

POTASSIUM IODATE KIO₃

SOLUBILITY OF POTASSIUM IODATE IN WATER.

The results of Kremers, 1856(a); Meerburg, 1905; Flöttman, 1928; Hill and Brown, 1931; and Ricci, 1931; above 100°, Benrath, Gjedebø, Schiffers and Wunderlich, 1937; were plotted and the following values taken from the average curve.

t°	d. of sat. sol.	Gms. KIO ₃ per 100 gms. sat. sol.	t°	d. of sat. sol.	Gms. KIO ₃ per 100 gms. sat. sol.	t°	Gms. KIO ₃ per 100 gms. sat. sol.
0	—	4.4	30	—	9.3	125	27.5
5	1.043	5.15	40	—	11.2	150	32.2
10	—	5.9	50	1.110	13.3	175	37.0
15	1.0584	6.68	60	—	15.5	200	41.5
20	1.0643	7.48	80	—	19.9	250	49.8
25	1.0708	8.40	100	—	24.4	300	58.0

KALIMUM

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POTASSIUM Hydrogen IODATES

SOLUBILITY OF EACH IN WATER.

Compound	Formula	t°	Gms. Compound per 100 gms. H ₂ O	Authority
Potassium Hydrogen Iodate	$\text{KH}(\text{IO}_3)_2$	15	1.3	(Serullas)
"	"	17	5.4	"
" Dihydrogen	$\text{KH}_2(\text{IO}_3)_2$	15	4.0	(Meineke, 1891.)

EQUILIBRIUM IN THE SYSTEM POTASSIUM IODATE, IODIC ACID, WATER AT 30°.
(Meerburg, 1905.)

Gms. per 100 Gms. Sat. Sol.		Solid Phase.	Gms. per 100 Gms. Sat. Sol.		Solid Phase.
HIO_3	KIO_3		HIO_3	KIO_3	
0	9.51	KIO_3	3.47	3.50	$\text{KIO}_3 \cdot 2\text{HIO}_3$ (unstable)
0.65	9.49	" + $\text{KIO}_3 \cdot \text{HIO}_3$	4.80	2.00	" "
0.65	8.90	$\text{KIO}_3 \cdot \text{HIO}_3$	6.45	1.35	" "
0.67	6.6	"	9.35	0.64	$\text{KIO}_3 \cdot 2\text{HIO}_3$
1.14	4.57	"	12.04	0.44	"
1.69	3.63	"	17.50	0.30	"
2.02	3.10	"	31.20	0.52	"
3.34	2.10	"	53.64	0.68	"
5	1.32	"	62.52	0.72	"
7.09	1	"	76.40	0.80	+ HIO_3
8.04	0.85	" + $\text{KIO}_3 \cdot 2\text{HIO}_3$	76.7	0	HIO_3

100 cc. anhydrous Hydrazine dissolve 1 gm. KIO_3 at room temp.

(Welsh and Broderick, 1915.)

SOLUBILITY OF POTASSIUM IODATE IN AQUEOUS SOLUTIONS OF
POTASSIUM NITRATE AND VICE VERSA.

(Hill and Brown, 1911.)

d. of sat. sol.	Gms. per 100		Solid Phase	d. of sat. sol.	Gms. per 100		Solid Phase
	KNO_3	KIO_3			KNO_3	KIO_3	
Results at 5°				Results at 25° (con.)			
1.043	0.00	5.25	KIO_3	1.212	26.84	4.24	$\text{KIO}_3 + \text{KNO}_3$
1.060	5.36	3.29	"	1.215	27.25	2.65	KNO_3
1.090	10.53	2.93	"	1.210	27.30	2.06	"
1.110	13.53	2.89	"	1.192	27.79	0.00	"
1.120	14.14	2.87	" + KNO_3				
1.100	14.26	1.08	KNO_3				
1.097	14.43	0.0	"				
				Results at 50.4°			

Results at 25° (con.)

Results at 25°							
1.072	0.0	8.46	KIO_3	1.110	0.0	11.35	KNO_3
1.084	5.48	5.92	"	1.167	17.42	7.32	"
1.110	8.51	5.25	"	1.259	11.93	5.79	"
1.156	16.77	4.57	"	1.33	19.17	5.17	"
1.160	18.19	4.48	"	1.35	42.42	4.91	"
				1.37	44.21	4.75	" + KNO_3
				1.34	45.44	2.44	KNO_3
				1.326	46.57	0.0	"

POTASSIUM IODATE KIO_3 .

SOLUBILITY OF POTASSIUM IODATE IN AQUEOUS SOLUTIONS OF
POTASSIUM HYDROXIDE AT 20°. (Brönsted, 1920a.)

Gms. mols. per liter.		Gms. mols. per liter.		Gms. mols. per liter.		Gms. mols. per liter.	
KOH.	KIO_3 .	KOH.	KIO_3 .	KOH.	KIO_3 .	KOH.	KIO_3 .
4.71	0.0390	7.95	0.0179	11.10	0.0128	14.02	0.0154
5.06	0.0362	9.41	0.0144	12.19	0.0131	14.85	0.0194
6.35	0.0256	10.95	0.0130	12.92	0.0135		

SOLUBILITY OF POTASSIUM IODATE IN AQUEOUS SOLUTIONS OF
POTASSIUM SULFATE AND VICE VERSA.

(Hill and Ricci, 1931.)

d. of	Gms. per 100		Solid Phase	d. of	Gms. per 100		Solid Phase
sat.	gms. sat. sol.			sat.	gms. sat. sol.		
sol.	K_2SO_4	KIO_3		sol.	K_2SO_4	KIO_3	

Results at 5°

1.043	0.0	5.16	KIO_3
1.060	4.07	3.14	"
1.081	7.08	2.57	" + K_2SO_4
1.077	7.25	1.80	K_2SO_4
1.062	7.64	0.0	"

Results at 25°

1.071	0.0	8.45	KIO_3
1.085	4.75	5.66	"
1.103	7.74	4.72	"
1.117	9.65	4.30	" + K_2SO_4

Results at 25° (con.)

1.103	10.10	2.44	K_2SO_4
1.083	10.76	0.0	"

Results at 50°

—	0.0	13.21	KIO_3
—	7.90	8.68	"
—	11.43	7.39	"
—	12.0	7.06	" + K_2SO_4
—	13.0	3.78	K_2SO_4
—	14.18	0.0	"

SOLUBILITY OF POTASSIUM IODATE IN AQUEOUS SOLUTIONS OF
SODIUM IODATE AND VICE VERSA.

(Hill and Ricci, 1931.)

d. of	Gms. per 100		Solid Phase	d. of	Gms. per 100		Solid Phase
sat.	gms. sat. sol.			sat.	gms. sat. sol.		
sol.	$NaIO_3$	KIO_3		sol.	$NaIO_3$	KIO_3	

Results at 5°

1.043	0.00	5.16	KIO_3
1.051	1.41	4.71	"
1.060	2.17	4.72	" + $NaIO_3 \cdot 5H_2O$
1.046	2.48	3.19	$NaIO_3 \cdot 5H_2O$
1.028	3.28	0.0	"

Results at 25°

1.071	0.0	8.45	KIO_3
1.098	4.26	7.09	"
1.126	7.13	6.73	" + $NaIO_3 \cdot H_2O$

Results at 25° (con.)

1.103	7.79	3.79	$NaIO_3 \cdot H_2O$
1.074	8.57	0.0	"

Results at 50°

—	0.0	13.21	KIO_3
—	3.92	11.92	"
—	7.70	11.14	"
—	10.92	10.61	" + $NaIO_3 \cdot H_2O$
—	11.41	7.93	$NaIO_3 \cdot H_2O$
—	12.55	4.24	"
—	13.49	0.0	"

POTASSIUM PERIODATE KIO_4 .

100 gms. H_2O dissolve 0.66 gm. KIO_4 at 13°, d_{13} of sat. solution = 1.0051.

(Barker, 1908.)

SOLUBILITY OF POTASSIUM PERIODATE IN WATER.
(Hill, 1928.)

t°	Gms. KIO_4 per 100 gms. sat. sol.	t°	Gms. KIO_4 per 100 gms. H_2O
0.2	0.169	50	1.44
5.4	0.21	75	3.59
15.0	0.334	97	6.83
25.0	0.510		

EQUILIBRIUM IN THE SYSTEM POTASSIUM PERIODATE,
POTASSIUM HYDROXIDE AND WATER AT 25°.
(Hill, 1928.)

d. of sat. sol.	Gms. per 100 gms. sat. sol.		Solid Phase	d. of sat. sol.	Gms. per 100 gms. sat. sol.		Solid Phase
	KOH	KIO_4			KOH	KIO_4	
1.000	0.0	0.51	KIO_4	1.326	8.0	20.8	$K_4I_2O_9 \cdot 9H_2O$
1.044	1.01	4.12	"	1.377	9.7	24.1	"
1.087	1.99	8.03	"	1.484	11.9	28.9	"
1.116	2.55	10.32	" + $KIO_4 \cdot H_2O$	1.64	14.5	35.2	"
1.165	4.55	13.15	$K_4I_2O_9 \cdot 9H_2O$	—	16.4	39.0	"
1.221	6.03	16.12	"	—	19.1	44.6	"

POTASSIUM Di-meso- Per IODATE $K_4I_2O_9 \cdot 9H_2O$

SOLUBILITY OF POTASSIUM DI-MESO-PERIODATE IN WATER.
(Hill, 1928.)

t°	d. of sat. sol.	Gms. $K_4I_2O_9$ per 100 gms. sat. sol.	Solid Phase	t°	d. of sat. sol.	Gms. $K_4I_2O_9$ per 100 gms. sat. sol.	Solid Phase
0.3	1.032	3.5	$K_4I_2O_9 \cdot 9H_2O$	50	1.395	35.0	$K_4I_2O_9 \cdot 9H_2O$
15.0	1.073	7.7	"	65	—	50.1	"
25.0	1.118	12.3	"	78	—	61.7	" + $K_4I_2O_9$
37.5	1.216	22.0	"	98.6	—	61.7	$K_4I_2O_9$

POTASSIUM Per IODATE

SOLUBILITY OF POTASSIUM META PERIODATE IN
AQUEOUS SOLUTIONS OF PERIODIC ACID AT 25°.
(Hill, 1928.)

d. of sat. sol.	Gms. per 100 gms. sat. sol.		Solid Phase
	KIO_4	KIO_4	
1.000	0.0	0.51	KIO_4
1.014	1.157	0.355	"
1.023	2.83	0.261	"

POTASSIUM PERMANGANATE KMnO_4 .

SOLUBILITY IN WATER. (Baxter, Boylston, and Hubbard, 1906; Patterson, 1906.)

t°.	Gms. KMnO_4 per 100:			t°.	Gms. KMnO_4 per 100:	
	Gms. Solution.	Gms. H_2O .	cc. Solution (P).		Gms. Solution.	Gms. H_2O .
0	2.75	2.83	2.84	34.8	9.64	10.67
9.8	4.13	4.31	...	40	11.16	12.56
15	...	...	5.22	45	12.73	14.58
19.8	5.96	6.34	...	50	14.45	16.89
24.8	7.06	7.59	...	55	16.20	19.33
29.8	8.28	9.03	8.69	65	20.02	25.03

Sp. Gr. of saturated solution at 15° = 1.035.

Determination by Worden (1907), made with extreme care, gave results in very close agreement with the above.

SOLUBILITY OF POTASSIUM PERMANGANATE IN WATER.

(Voerman, 1905, 1906.)

t°.	Gms. KMnO_4 per 100 gms.		Solid Phase	t°.	Gms. KMnO_4 per 100 gms.		Solid Phase.
	sat. sol.	water.			sat. sol.	water.	
-0.18.....	0.58	0.58	Ice	+10.....	4.01	4.22	KMnO_4
-0.27.....	0.99	1.01	"	15.....	4.95	5.20	"
-0.48.....	1.98	2.02	"	25.....	7.00	7.53	"
-0.58 Eutec.	2.91	3.00	" + KMnO_4	40.....	11.09	12.47	"
				50.....	14.35	16.75	"

SOLUBILITY OF POTASSIUM PERMANGANATE IN WATER.

(Flückmann, 1928.)

t°	d. of sat. sol.	Gms. KMnO_4 per 100 gms. sat. sol.	Solid Phase
15	1.0342	4.997	KMnO_4
20	1.0397	5.946	"
25	1.0461	7.079	"
25	1.0461	7.097	" (Trimble, 1922.)

SOLUBILITY OF POTASSIUM PERMANGANATE AT 25° IN AQUEOUS SOLUTIONS OF :
(Trimble, 1922.)

Potassium Sulfate.				Sodium Sulfate.			
d_{25}^4 of sat. sol.	Gms. per 100 gms. sat. sol.		Solid Phase.	d_{25}^4 of sat. sol.	Gms. per 100 gms. sat. sol.		Solid Phase.
	K_2SO_4 .	KMnO_4 .			Na_2SO_4 .	KMnO_4 .	
1.0454	0.0	7.10	KMnO_4	1.0554	0.88	7.33	KMnO_4
1.0483	0.80	6.59	"		4.62	7.83	"
1.0537	1.98	5.92	"	1.1180	7.05	7.75	"
1.0730	5.47	4.52	"		9.34	7.67	"
1.0876	7.79	3.87	"		12.85	7.27	"
1.0979	9.26	3.55	" + K_2SO_4		17.05	6.68	"
1.0864	10.75	0.00	K_2SO_4	1.2363	19.43	6.25	"
					21.04	5.91	" + Na_2SO_4 eff. 0
				1.2071	21.80	0.0	$\text{Na}_2\text{SO}_4 \cdot 10 \text{H}_2\text{O}$

The author also gives data for the densities of aqueous solutions of KMnO_4 , K_2SO_4 , and of Na_2SO_4 . He also gives a few determinations of the solubility of KMnO_4 in aqueous solutions of mixtures of K_2SO_4 and Na_2SO_4 .

SOLUBILITY OF POTASSIUM PERMANGANATE IN AQUEOUS SOLUTIONS OF POTASSIUM CARBONATE.

(Sackur and Taegener, 1912.)

Mols. KMnO_4 per Liter in:

t°.	0.1 n $\frac{1}{2}\text{K}_2\text{CO}_3$.	1 n $\frac{1}{2}\text{K}_2\text{CO}_3$.	2 n $\frac{1}{2}\text{K}_2\text{CO}_3$.	4 n $\frac{1}{2}\text{K}_2\text{CO}_3$.	6 n $\frac{1}{2}\text{K}_2\text{CO}_3$.
0	0.1462	0.0620	0.0446	0.027	0.0156
25	0.4375	0.2589	...	0.093	...
40	0.7380	0.5007	0.3519	...	...

SOLUBILITY OF POTASSIUM PERMANGANATE IN AQUEOUS SOLUTIONS OF POTASSIUM CHLORIDE.

(Sackur and Taegener, 1912.)

Mols. KMnO_4 per Liter in:

t°.	0.1 n KCl.	0.5 n KCl.	1 n KCl.	2 n KCl.
0	0.1395	0.076	0.0532	0.0379
25	0.4315	0.306	0.220	0.1432
40	0.738	0.584	0.444	0.288

SOLUBILITY OF POTASSIUM PERMANGANATE IN AQUEOUS SOLUTIONS OF POTASSIUM HYDROXIDE.

(Sackur and Taegener, 1912.)

Mols. KMnO_4 per Liter in:

t°.	H_2O .	1 n KOH.	2 n KOH.	4 n KOH.	6 n KOH.	8 n KOH.	10 n KOH.
0	0.176	0.050	0.031	0.027	0.023	0.017	0.012
10	0.278	0.112	0.068	0.048	0.042	0.028	0.016
20	0.411	0.179	0.119	0.079	0.074 (19°)	0.032	0.029
30	0.573	0.316 (32°)	0.213 (32°)	0.149 (32°)	0.114	0.062 (32°)	0.040
40	0.792	0.439	0.306	0.211	0.161	0.084	0.052
50	1.154 (53°)	0.638	0.462	0.304	0.219	0.111	...
70	1.812	1.172	0.869	0.572	0.390	0.188	0.082
80	...	1.513	1.190	...	0.500	0.231	...
90	...	...	...	...	0.649	0.297	...

SOLUBILITY OF POTASSIUM MANGANATE IN AQUEOUS SOLUTIONS OF POTASSIUM HYDROXIDE.

(Sackur and Taegener, 1912.)

(The K_2MnO_4 was prepared by boiling KMnO_4 with very conc. KOH, draining by suction and washing with ice cold K_2CO_3 solution. The impurities were of no consequence since the determinations were made in alkaline solutions.)

Mols. K_2MnO_4 per Liter in:

t°.	2 n KOH.	4 n KOH.	6 n KOH.	8 n KOH.	10 n KOH.
0	0.907	0.554	0.155	0.063	0.0145
10	1.013	...	...	0.070	0.0152
15	...	0.681 (17°)	0.224	...	...
20	1.140	0.733 (25°)	0.261 (21°)	0.078	0.0160
30	1.252	0.772	0.303	0.096	0.0215
40	...	0.852	0.362	0.119	0.0305
45	1.424	0.880	0.388	...	...
50	...	0.938 (51°)	...	0.142	0.0462
60	...	1.003	0.460	0.167	0.062 (63°)
70	...	1.074	0.528	0.196	0.070
80	...	1.143	0.587	0.222	0.083

100 cc. anhy. hydrazine dissolve 2 gms. KMnO_4 , with evolution of gas and formation of a brown precipitate, at room temp.

(Welsh and Broderston, 1915.)

POTASSIUM Per MANGANATE

SOLUBILITY OF POTASSIUM PERMANGANATE IN AQUEOUS SOLUTIONS
OF SALTS AT 25°.

(Herz and Hieenthal, 1929.)

Results for Aqueous Solutions of:

Lithium Chloride		Sodium Chloride		Ammonium Chloride	
Gm. Mols. per liter		Gm. Mols. per liter		Gm. Mols. per liter	
LiCl	$1/5\text{-KMnO}_4$	NaCl	$1/5\text{-KMnO}_4$	NH_4Cl	$1/5\text{-KMnO}_4$
0.0	2.25	0.59	2.32	0.59	1.94
0.51	2.18	0.96	2.29	0.95	1.75
0.87	2.09	2.26	2.13	2.69	1.05
2.56	1.51	3.35	1.86	3.78	0.86
3.81	1.16	4.22	1.73	4.57	0.78
4.56	0.95	+5.15	1.53	+5.45	0.72

Magnesium Chloride		Calcium Chloride		Strontium Chloride	
Gm. Mols. per liter		Gm. Mols. per liter		Gm. Mols. per liter	
$1/2\text{-MgCl}_2$	$1/5\text{-KMnO}_4$	$1/2\text{-CaCl}_2$	$1/5\text{-KMnO}_4$	$1/2\text{-SrCl}_2$	$1/5\text{-KMnO}_4$
0.96	2.01	0.0	2.35	0.0	2.25
1.92	1.78	1.70	2.00	0.64	2.27
4.62	0.96	4.90	1.20	2.45	1.94
6.42	0.64	6.80	0.91	3.92	1.64
7.64	0.48	8.10	0.80	4.52	1.50
8.10	0.40			+5.90	1.36
+9.52	0.16				

Mn

Potassium Chloride

Gm. Mols. per liter		Gm. Mols. per liter	
KCl	$1/5\text{-KMnO}_4$	KCl	$1/5\text{-KMnO}_4$
0.36	1.56	2.32	0.58
0.61	1.30	2.89	0.51
1.65	0.74	4.06	0.40

SOLUBILITY OF POTASSIUM PERMANGANATE IN AQUEOUS SOLUTIONS
OF ACETONE AT 13°.

(Herz and Knock, 1904.)

cc CH_3COCH_3 per 100cc solvent	Gms. KMnO_4 per 100cc sat. sol.	cc CH_3COCH_3 per 100cc solvent	Gms. KMnO_4 per 100cc sat. sol.
0.0	4.70	60	10.02
10.0	5.13	70	10.38
20	5.61	80	9.89
30	6.59	90	7.18
40	8.14	100	2.14
50	9.16		

KALIAM

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SOLUBILITY OF MIXED CRYSTALS OF POTASSIUM PERMANGANATE AND
RUBIDIUM PERMANGANATE AT 7°.
(Muthmann and Kuntze, calc. by Fock.)

Milligram Mols. per Liter.		Gms. per Liter.		Mol. per cent KMnO ₄ in Crystals of Solid Phase.
KMnO ₄ .	RbMnO ₄ .	KMnO ₄ .	RbMnO ₄ .	
27.04	22.69	4.28	4.64	3.50
75	22.22	11.84	4.54	13.75
120.26	31.29	19.03	6.40	34.29
188.30	38.98	29.80	7.97	71.45
198.36	41.20	31.39	8.44	92.50
205.76	42.50	32.56	8.69	99.47
225.12	26	35.61	5.32	99.32
264.27	0	41.81	0	100

POTASSIUM MOLYBDATE K₂MoO₄

SOLUBILITY OF POTASSIUM MOLYBDATE IN AQUEOUS SOLUTIONS OF POTASSIUM
SULFATE AT 25° AND VICE VERSA.
(Amadori, 1912a.)

Gms. per 100 Gms. H ₂ O.		Gms. per 100 Gms. H ₂ O.	
K ₂ SO ₄ .	K ₂ MoO ₄ .	K ₂ SO ₄ .	K ₂ MoO ₄ .
0	184.6	1.50	99.49
0.46	180.7	2.13	45.89
0.72	177	3.95	17.48
0.98	127.2	8.55	4.73
1.27	107.5	12.10	0

Freezing-point data for K₂MoO₄ + K₂SO₄, K₂MoO₄ + K₂WO₄ and K₂Mo₂O₇ + K₂W₂O₇ are given by Amadori (1913).

Results for K₂MoO₄ + MoO₃ and K₂MoO₄ + Li₂MoO₄ and K₂WO₄ + WO₃ are given by Hoermann, 1929.

POTASSIUM PHOSPHOMOLYBDATE K₃PO₄·11MoO₃·1½H₂O.

100 gms. H₂O dissolve 0.0007 gm. at 30°.

100 gms. aqueous 10% HNO₃ dissolve 0.204 gm. at 30°. (Donk, M. G., 1905.)

POTASSIUM PHOSPHOMOLYBDATE

SOLUBILITY OF POTASSIUM PHOSPHOMOLYBDATE IN AQUEOUS SOLUTIONS OF
POTASSIUM NITRATE. (Heidenhain, 1918.)

In order to avoid errors due to impurities in the phosphomolybdate, small quantities of the washed precipitate were digested for a time long enough to insure saturation, and the dissolved part determined either by evaporation and weighing or by titration. The temperature is not stated.

Gms. per 100 cc. Aq. solvent.		Gms. P ₂ O ₅ per 100 cc. sat. sol.	Gms. per 100 cc. Aq. solvent.		Gms. P ₂ O ₅ per 100 cc. sat. solution.
KNO ₃ .	HNO ₃ .		KNO ₃ .	HNO ₃ .	
10	0.0	1.30	10	0.0504	0.12
15	0.0	1.30	10	0.0552	0.18
20	0.0	1.30	10	0.0126	0.49
10	0.063	0.06			

POTASSIUM PHOSPHOTUNGSTATE

1000 cc. sat. solution of potassium phosphotungstate in water contain 0.135 gm. of the compound at 20°. (Moser and Ritschel, 1925.)

POTASSIUM AMIDE KNH_2 .

100 gms. liquid ammonia dissolve 3.6 gms. KNH_2 at 25° . (Hunt and Boncyk, 1933.)

Data for the freezing-points of mixtures of potassium amide and sodium amide are given by Kraus, 1923.

POTASSIUM AZIDE KN_3 .**SOLUBILITY OF POTASSIUM AZIDE IN WATER.**

(Wohlgemuth, 1934.)

The results are given in the form of a diagram but numerical values only for the following points.

t°	Gms. KN_3 per 100 gms. $\text{KN}_3 + \text{H}_2\text{O}$	Solid Phase
-12.9 (Eutec.)	26.2	$\text{KN}_3 + \text{H}_2\text{O}$
0	29.3	KN_3
10.5	31.7	"
15.5	32.8	"
17.0	33.2	"
100	51.4	"
354 (m. pt.)	100.0	"

The results at 10.5, 15.5 and 17.0 are by Curtius and Rissom, 1898.

100 gms. Alcohol ($d_{17} = 0.799$) dissolve 0.16 gm. KN_3 at 0° and 0.54 gm. at b. pt.

100 gms. Alcohol (80 per cent) dissolve 1.8 gm. KN_3 at 0° and 5.9 gm. at b. pt.

100 gms. Benzene dissolve 0.15 gm. KN_3 at b. pt.

(Cranston and Livingstone, 1926.)

POTASSIUM NITRITE KNO_2 .**SOLUBILITY IN WATER.**

(Oswald, 1912, 1914.)

t°	Gms. KNO_2 per 100 Gms. Sat. Sol.	Solid Phase.	t°	Gms. KNO_2 per 100 Gms. Sat. Sol.	Solid Phase.
-4.1	16.1	Ice	+17.5	74.5*	KNO_2
-7.6	24.1	"	25	75.75	"
-13.8	40.2	"	40	77	"
-18.6	50.1	"	55	77.5	"
-24.6	61.7	"	75	78.5	"
-30	69.8	"	100	80.5	"
-31.6 Eutec.	71.8	" + KNO_2	111	80.7	"
-6.5	73.2	KNO_2	119	81.15	"
0	73.6	"	125	81.8	"

* $d_{17.4} = 1.6161$.

100 gms. H_2O dissolve about 300 gms. KNO_2 at 15.5° .

(Divers, 1899.)

The figure 138.5 gms. KNO_2 per 100 gms. H_2O at 15° , given by von Niementowski and von Roszkowski (1897), is evidently low.

KALIMUM.

POTASSIUM NITRITE KNO_2 .

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SOLUBILITY OF POTASSIUM NITRITE IN WATER.

(Bureau, 1935a, 1937.)

t°	Gms. KNO_2 per 100 gms. sat. sol.		Solid Phase
-5.20	13.01		Ice
-12.25	27.85		"
-20.45	41.0		"
-34.04	58.8		"
-40.2 (Eutec.)	64.9		" + $\text{KNO}_2 \cdot 5\text{H}_2\text{O}$
-26.8	68.4		$\text{KNO}_2 \cdot 5\text{H}_2\text{O}$

t°	d. of sat. sol.	Gms. KNO_2 per 100 gms. sat. sol.	Solid Phase	t°	Gms. per 100 gms. sat. sol.
-8.9 (tr.pt.)	—	71.9	$\text{KNO}_2 + \text{KNO}_2 \cdot 5\text{H}_2\text{O}$	0	73.65
+20.0	1.649	74.3	KNO_2	20	75.41
56.0	1.671	76.36	"	40	77.00
64.7	1.673	77.0	"	60	77.75
79.5	1.687	78.5	"	80	78.98
98.5	1.714	78.9	"	98	80.35

NO The above results for the ice curve differ from those of Oswald, 1912, 1914. They also show the existence of the hydrate, $\text{KNO}_2 \cdot 5\text{H}_2\text{O}$. The results between 0° and 98° are by Rakowski and Slavina, 1931. These authors also give results for the ice curve which agree with those of Oswald, 1912, 1914.

SOLUBILITY OF POTASSIUM NITRITE IN AQUEOUS SOLUTIONS OF POTASSIUM NITRATE AND VICE VERSA.

(Bureau, 1937.)

Results in the form of a diagram are presented for the temperatures, 0° , 25° , 56.6° and 98.5° but numerical values are given only for the temperatures 25° and 98.5° .

Results at 25°

Gms. per 100 gms. sat. sol.	
KNO_2	KNO_3
68.7	8.53
66.45	11.20
64.15	13.05
61.5	15.10
55.8	14.95
35.85	15.05
19.90	18.75

Solid Phase
MC, $\text{KNO}_2 + \text{KNO}_3$
" " "
" " "
βKNO_3
" "
α "
" "

Results at 98.5°

Gms. per 100 gms. sat. sol.	
KNO_2	KNO_3
64.80	14.80
57.0	13.80
51.10	35.15
46.70	39.15
39.70	43.80
20.45	55.40

Solid Phase
MC, $\text{KNO}_2 + \text{KNO}_3$
" " "
" " "
" " "
KNO_3
" "

MC, $\text{KNO}_2 + \text{KNO}_3$ = Mixed Crystals. Data for this system at 0° , 20° , 40° , 60° , 80° and 98° are also given by Rakowsky and Slavina, 1931, but the results are not in good accord with the above.

POTASSIUM Cobalti NITRITE $K_3Co(NO_2)_6$.

SOLUBILITY OF POTASSIUM COBALTI NITRITE IN AQUEOUS ALCOHOL AT 14°.
(Pierrat, 1921.)

NOTE. — Saturation was obtained by agitation for several hours. The saturated solution was evaporated to dryness in a current of air and enough water to yield the original volume of the solution was added. The nitrite in this solution then determined by calculations from the electrolytic conductivity.

Wt. per cent C_2H_5OH in solvent.	Gms. $K_3Co(NO_2)_6$ per liter sat. sol.	Wt. per cent C_2H_5OH in solvent.	Gms. $K_3Co(NO_2)_6$ per liter sat. sol.
0.0	0.21	27.3	0.036
8.7	0.09	42.4	0.033
15.7	0.056	94.7	0.026

Data for the fusion-points of mixtures of $KNO_2 + KNO_3$ are given by Meneghini, 1912, and for mixtures of $KNO_2 + NaNO_2$ by Ettinger, 1932.

POTASSIUM NITRATE**SOLUBILITY IN WATER.**

(Mulder; Andræ, 1884; Gerardin, 1865; Etard, 1894; Ost, 1878; at 31.25°, Köhler, 1897; Euler, 1904; Tilden and Shenstone, 1884; Berkeley, 1904.)

Average Curve.

t°.	Gms. KNO_3 per 100 Gms.		t°.	Gms. KNO_3 per 100 Gms.	
	Water.	Solution.		Water.	Solution.
0	13.3	11.7	70	138	58.0
10	20.9	17.3	80	169	62.8
20	31.6	24.0	90	202	66.9
25	37.3	27.2	100	246	71.1
30	45.8	31.4	110	300	75.0
40	63.9	39.0	120	394	79.8
50	85.5	44.0	125	493	83.1
60	110.0	52.0			

NO

The very carefully determined figures of Berkeley are as follows:

t°.	d_4 of Sat. Sol.	Gms. KNO_3 per 100 Gms. H_2O .	t°.	d_4 of Sat. Sol.	Gms. KNO_3 per 100 Gms. H_2O .
0.40	1.0817	13.43	60.05	1.3903	111.18
14.90	1.1389	25.78	76	1.4700	156.61
30.80	1.2218	47.52	91.65	1.5394	210.20
44.75	1.3043	74.50	114 b. pt.	1.6269	311.64

1000 gms. H_2O dissolve 384.48 gms. KNO_3 at 25°. (Armstrong and Eyré, 1916-11.)
One liter sat. solution in water contains 2.8 mols. = 283.11 gms. KNO_3 at 20°.

(Rosenheim and Weinheber, 1910-11.)

Recent determinations of the solubility of potassium nitrate in water, agreeing satisfactorily with the above data, are given by Chugaev and Khlopin (1914).

SOLUBILITY OF POTASSIUM NITRATE IN WATER.

Determination at temperatures up to 60° made by Massink, 1917-18; Gladstone and Saunders, 1923; Wright, 1927; Malpuori, 1928; Nikolajew, 1929; Benrath and Wazelle, 1929; Ehret, 1932; Muller, 1933; Ricci, 1934; and Saslowsky and Ettinger, 1935; and for temperatures above 100° by Brönsted, 1913; Aronowa and Lumskaia, 1931 and Benrath, Gjedebø, Schiffers and Wunderlich, 1937, were plotted and the following values taken from the average curve drawn through them.

t°	Gms. KNO ₃ per 100 gms. sat. sol.	t°	Gms. KNO ₃ per 100 gms. sat. sol.	t°	Gms. KNO ₃ per 100 gms. sat. sol.
-2.84 (Eutec.)	10.87	60	51.5	180	87.0
0	12.2	70	57.5	200	89.0
10	17.5	80	62.5	225	91.7
20	24.0	90	67.0	250	93.5
25	27.5	100	71.0	275	96.0
30	31.2	120	77.5	300	98.0
40	38.0	140	81.5	336 (m.pt.)	100.0
50	45.5	160	85.0		

POTASSIUM NITRATE KNO₃.

SOLUBILITY ICE CURVE AND SUPERSOLUBILITY ICE CURVE.

(Jones, 1908.)

t° of Cryst.	Gms. KNO ₃ per 100 Gms. H ₂ O.		t° of Cryst.	Gms. KNO ₃ per 100 Gms. H ₂ O.	
	Solubility Ice Curve.	Supersolubility Ice Curve.		Solubility Ice Curve.	Supersolubility Ice Curve.
-1	3.336	1.011	-3	...	5.762
-2	7.582	3.538	-4	...	8.694
-2.8*	11.62	5.56	-5	...	11.12
			-5.3*	...	11.82

* Cryohydrate.

SOLUBILITY OF POTASSIUM NITRATE IN AQUEOUS SOLUTIONS OF NITRIC ACID AT 0°.

(Engel — Compt. rend. 104, 913, '37.)

Sp. Gr. of Solutions.	Equivalents per 10 cc. Solution.				Grams per 100 cc. Solution.			
	12.5 KNO ₃	0	HNO ₃		12.65 KNO ₃	0.00 HNO ₃		
1.079	9.9	"	5.87	"	10.02	"	3.71	"
...	9.9	"	5.87	"	10.02	"	3.71	"
1.093	8.28	"	13.2	"	8.38	"	8.38	"
1.117	7.4	"	21.55	"	7.49	"	13.58	"
1.144	7.4	"	31.1	"	7.49	"	19.47	"
1.202	7.6	"	48.0	"	7.68	"	30.04	"
1.289	10.3	"	68.0	"	10.42	"	42.86	"
1.498	28.3	"	120.5	"	28.64	"	75.95	"

Freezing-point data for KNO₃ + HNO₃ are given by Dernby (1918).

SOLUBILITY OF POTASSIUM NITRATE IN AQUEOUS SOLUTIONS OF NITRIC ACID AT 20°.

(Nichols, Howe et al., 1919.)

Per cent HNO ₃ in solvent.	Gms. KNO ₃ per 100 gms. solvent.	Per cent HNO ₃ in solvent.	Gms. KNO ₃ per 100 gms. solvent.	Per cent HNO ₃ in solvent.	Gms. KNO ₃ per 100 gms. solvent.
0.0	31.4	40.0	15.0	70	29.6
10.0	19.1	50	18.6	80	34.2
20.0	14.5	60	19.6	90	48.8
30.0	11.4				

SOLUBILITY OF POTASSIUM NITRATE IN AQUEOUS SOLUTIONS
OF NITRIC ACID AT 25°. (Malquori, 1923c.)

Gms. per 100 gms. sat. sol.		Gms. per 100 gms. sat. sol.	
HNO ₃	KNO ₃	HNO ₃	KNO ₃
0.00	27.31	29.56	35.10
10.30	25.03	44.17	43.28
13.97	24.13	50.01	49.99
20.11	26.12		

SOLUBILITY OF POTASSIUM NITRATE IN AQUEOUS SOLUTIONS OF NITRIC ACID
AT SEVERAL TEMPERATURES. (Kazantzev, 1923, 1925.)

Constant agitation was employed for securing saturation. One to two hours was found sufficient in all cases for the attainment of equilibrium.

Results at 0°.		Results at 15°.		Results at 30°.		Results at 75°.	
Gms. per 100 gms. sat. sol.		Gms. per 100 gms. sat. sol.		Gms. per 100 gms. sat. sol.		Gms. per 100 gms. sat. sol.	
HNO ₃	KNO ₃	HNO ₃	KNO ₃	HNO ₃	KNO ₃	HNO ₃	KNO ₃
0.0	11.9	0.0	20.7	0.0	31.5	0.0	60.0
1.3	11.0	7.5	14.2	5.4	25.6	5.1	53.6
4.7	8.5	18.0	10.7	11.0	20.9	17.7	41.3
8.7	7.2	23.3	10.1	18.2	17.2	21.8	38.9
13.2	6.4	24.0	10.2	27.2	15.7	29.3	37.4
16.5	6.1	29.2	10.5	40.1	18.9	32.2	36.7
25.5	6.4	40.0	13.6	47.7	27.7	38.5	37.6
30.1	7.0	45.1	17.7	49.0	33.2	42.5	39.9
33.5	7.5	49.3	25.1	50.1	39.5	45.5	43.9
39.9	9.7	51.0	32.7	50.6	42.5	46.7	50.0
48.0	16.5	51.6	38.1	49.7	49.9	46.2	52.6
50.7	23.1	51.3	44.1				
52.2	30.2	50.0	49.2				
52.2	38.2						
52.2	39.4						
50.7	48.4						
57.5	34.4	(Solid Phase = KNO ₃ · 2HNO ₃)					
73.0	25.5	(" " ")					

SOLUBILITY OF POTASSIUM NITRATE IN AQUEOUS SOLUTIONS OF
POTASSIUM HYDROXIDE AT 20°. (Brønsted, 1920 a).

Gm. mols. per liter		Gm. mols. per liter		Gm. mols. per liter	
KOH.	KNO ₃ .	KOH.	KNO ₃ .	KOH.	KNO ₃ .
4.71	0.847	9.41	0.364	14.02	0.241
7.90	0.455	10.95	0.298	14.85	0.232
7.95	0.450	12.19	0.271	15.02	0.233

SOLUBILITY OF POTASSIUM NITRATE AND OF ACID POTASSIUM NITRATES IN NITRIC ACID.

(Groschuff — Ber. 37, 1490, '04.)

NOTE. — Determinations made by the so-called thermometric method, *i.e.*, by observing the temperature of the disappearance of the separated, finely divided solid from solutions of known concentration.

t°.	Gms. per 100 Gms. Solution.		Solid Phase.	t°.	Gms. per 100 Gms. Solution.		Solid Phase.
	KNO ₃ .	HNO ₃ .			KNO ₃ .	HNO ₃ .	
— 6	24.4	75.41	KNO ₃ .2HNO ₃ (?)	22.5	47.2	52.93	KNO ₃ .HNO ₃
+14	32.6	67.42	" (stabil)	23.5	47.8	52.11	" (stabil)
17	34.8	65.04	"	25.5	48.6	51.46	"
19.5	37.2	62.90	"	27.0	49.4	50.78	"
22	44.5	55.46	"	29.0	50.1	49.94	KNO ₃ .HNO ₃
21.5	47.8	52.11	KNO ₃ .2HNO ₃ (?)	30.5	50.0	49.15	" (labil)
21.5	48.6	51.46	" (labil)	21.0	49.4	50.78	KNO ₃ (labil)
20	50.9	49.15	"	39.0	50.9	49.15	" (stabil)
— 4	37.2	62.81	KNO ₃ .HNO ₃	50	51.7	48.32	
—16.5	44.5	55.46	" (labil)				

(1) Solution in HNO₃.

(2) Solution in KNO₃.

CONDUCT OF ACID POTASSIUM NITRATE TOWARDS WATER.

t°.	Gms. per 100 Gms. Solution.		Solid Phase.	t°.	Gms. per 100 Gms. Solution.		Solid Phase.
	KNO ₃ .	HNO ₃ .			KNO ₃ .	HNO ₃ .	
22	44.5	55.5	KNO ₃ .2HNO ₃	50	38.7	48.3	KNO ₃
20.5	44.1	55.0	"	61	36.0	44.8	"
18	43.8	54.5	"	63	34.5	43.0	"
12	43.0	53.6	"	60.5	30.9	39.5	"
6	42.3	52.7	"	56	27.6	34.4	"
0	41.6	51.8	"	43	20.8	25.9	"
12	41.3	51.4	KNO ₃	17	11.7	14.6	"
22	40.9	51.0	"	—5	5.54	6.91	"
40	39.9	49.8	"				

SOLUBILITY OF MIXTURES OF POTASSIUM NITRATE AND POTASSIUM CHLORIDE IN WATER.

(Etard — Ann. chim. phys. [7] 3, 283, '92; at 20°. Rüdorff — Ber. 6, 482, '73; Nicol — Phil. Mag. [5] 31, 385, '91)

t°.	Gms. per 100 Gms. Solution.		t°.	Gms. per 100 Gms. Solution.		t°.	Gms. per 100 Gms. Solution.	
	KNO ₃ .	KCl.		KNO ₃ .	KCl.		KNO ₃ .	KCl.
0	5.0	20.0	30	16.0	21.2	70	39.5	17.5
10	8.0	20.8	40	21.0	21.0	80	45.5	15.8
20	12.6	21.2	50	27.0	20.0	100	57.5	11.6
25	14.0	21.3	60	33.5	19.0	120	69.0	7.7

POTASSIUM NITRATE

EQUILIBRIUM IN THE SYSTEM POTASSIUM OXIDE, NITROGEN
TRIOXIDE AND WATER AT 25°.
(Nikolajew, 1928.)

Acid Branch			Alkaline Branch		
Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase
HNO ₃	KNO ₃		KOH	KNO ₃	
0.0	27.87	KNO ₃	5.11	20.36	KNO ₃
9.89	19.00	"	12.25	13.31	"
16.68	15.27	"	17.38	9.59	"
32.29	14.02	"	29.65	4.60	"
42.57	17.15	"	39.82	2.49	"
49.53	25.37	"	49.79	1.14	"
			50.85	1.05	" + KOH
			54.18	0.0	KOH

This author also gives results for equilibrium in the system KNO₃ + NaNO₃ + HNO₃ + H₂O at 25°.

SOLUBILITY OF POTASSIUM NITRATE IN AQUEOUS SOLUTIONS
OF HYDROGEN PEROXIDE AT 25°.
(Akerlof and Turck, 1935.)

Wt. Percent H ₂ O ₂ in Aq. Solvent	Gm. Mols. KNO ₃ per 1000 gms. Solvent
0.0	3.774
15.72	4.710
31.43	5.762

SOLUBILITY OF POTASSIUM NITRATE IN AQUEOUS SOLUTIONS OF:
(Touren — Compt. rend. 131, 259, '00.)

Potassium Carbonate.

Potassium Bi Carbonate.

Results at 14.5°.			
Mols. per Liter		Gms. per Liter.	
K ₂ CO ₃	KNO ₃	K ₂ CO ₃	KNO ₃
0.0	2.228	0.0	225
0.48	1.85	66.4	188
1.25	1.39	172.9	141
2.58	0.86	356.9	87
3.94	0.64	544.9	65
Results at 25°.			
0.0	3.217	0.0	326
0.59	2.62	81.6	265
1.35	1.97	186.7	199
2.10	1.46	290.5	148
2.70	1.14	373.6	115
3.58	0.79	495.1	80

Results at 14.5°.			
Mols. per Liter.		Grams per Liter.	
KHCO ₃	KNO ₃	KHCO ₃	KNO ₃
0.0	2.33	0.0	236
0.39	2.17	39.0	220
0.76	2.03	76.0	205
1.16	1.92	116	194
1.55	1.81	155	183
Results at 25°.			
0.0	3.28	0.0	332
0.89	2.84	89	287
1.33	2.65	133	268
1.91	2.45	191	249

SOLUBILITY OF POTASSIUM NITRATE IN AQUEOUS SOLUTIONS OF POTASSIUM CARBONATE AT 24.2°.
(Kremann and Zitek, 1909.)

Gms. per 1000 Gms. H ₂ O.		Solid Phase.	Gms. per 1000 Gms. H ₂ O.		Solid Phase.
KNO ₃ .	K ₂ CO ₃ .		KNO ₃ .	K ₂ CO ₃ .	
376.8	0	KNO ₃	73	688.1	KNO ₃
285	130.3	"	38.8	878.3	"
161.7	348.4	"	31.1	1112.2	" + K ₂ CO ₃
141.8	371.9	"			

1000 gms. H₂O containing 1 mol. KCl (101.11 gms.) dissolve 324.85 gms. KNO₃ at 25°.
(Armstrong and Eyre, 1910-11.)

Data for the system potassium nitrate, potassium sulfate, water at 35° are given by Massink (1916, 1917).

SOLUBILITY OF POTASSIUM NITRATE IN AQUEOUS SOLUTIONS OF POTASSIUM SULFATE AND VICE VERSA AT SEVERAL TEMPERATURES.
(Inouye, 1923; Massink, 1918; Hamid, 1926.)

t°.	Gms. per 100 gms. sat. sol.		Solid Phase.	t°.	Gms. per 100 gms. sat. sol.		Solid Phase.
	KNO ₃ .	K ₂ SO ₄ .			KNO ₃ .	K ₂ SO ₄ .	
25...	27.64	0.0 (I)	KNO ₃	25...	5.84	8.12 (I)	K ₂ SO ₄
25...	27.33	1.64 (I)	"	25...	4.80	8.85 (H)	"
25...	26.01	1.98 (H)	"	35...	11.76	0.0 (M)	KNO ₃
25...	25.91	3.00 (I)	"	35...	12.61	1.17 (M)	"
25...	25.37	3.95 (I)	" + K ₂ SO ₄	35...	10.76	3.42 (M)	" + K ₂ SO ₄
25...	23.99	4.45 (H)	" "	35...	16.29	6.47 (M)	K ₂ SO ₄
25...	14.52	5.89 (I)	K ₂ SO ₄	35...	0.0	12.17 (M)	"
25...	11.05	6.89 (H)	"	90...	65.97	0.63 (H)	" + KNO ₃

100 gms. solution simultaneously saturated with potassium nitrate and sodium nitrate contain 45.26 gms. KNO₃ + 37.57 gms. NaNO₃ at 90°. (Hamid, 1926.)

Data for the quaternary system KNO₃ + K₂SO₄ + NaNO₃ + Na₂SO₄ + H₂O at 25° and at 90° are given by Hamid, 1926.

SOLUBILITY OF MIXTURES OF POTASSIUM NITRATE AND POTASSIUM SULPHATE IN WATER.
(Euler — Z. physik. Ch. 40, 193, '04.)

t°.	Sp. Gr. of Sat. Solution.	Grams per 100 Grams Water.	
		KNO ₃	K ₂ SO ₄
15	1.165	24.12	5.65
20	...	30.10	5.58
25	1.210	36.12	5.58

POTASSIUM NITRATE

SOLUBILITY OF POTASSIUM NITRATE IN AQUEOUS SOLUTIONS
OF POTASSIUM SULFATE AND VICE VERSA.

(Hering, 1926, 1927.)

d. of sat. sol.	Gms. per 100 gms. H ₂ O		Solid Phase	d. of sat. sol.	Gms. per 100 gms. H ₂ O		Solid Phase
	KNO ₃	K ₂ SO ₄			KNO ₃	K ₂ SO ₄	
Results at -3.32° (Eutec)				Results at 40°			
—	10.3	4.7	Ice+KNO ₃ +K ₂ SO ₄	1.287	61.0	5.00	KNO ₃ +K ₂ SO ₄
Results at 0°				Results at 50°			
—	13.3	0.0	KNO ₃	1.339	83.3	3.20	KNO ₃
—	12.4	3.56	"	1.341	82.5	4.53	" + K ₂ SO ₄
—	12.2	4.95	" + K ₂ SO ₄	1.301	68.7	4.54	K ₂ SO ₄
—	11.0	5.05	K ₂ SO ₄	1.203	34.9	7.9	"
—	6.4	5.74	"	1.171	24.9	9.2	"
—	0.0	7.33	"	1.152	18.0	10.6	"
				1.104	0.0	16.5	"
Result at 8.5°				Results at 75°			
—	18.1	5.45	KNO ₃ +K ₂ SO ₄	1.467	150.5	3.33	KNO ₃ +K ₂ SO ₄
Result at 17.5°				1.433	131.2	3.71	K ₂ SO ₄
1.176	22.7	5.77	KNO ₃ +K ₂ SO ₄	1.380	105.5	4.53	"
				1.335	86.2	5.18	"
Result at 20°				1.268	60.5	7.01	"
1.187	3.0	5.73	KNO ₃ +K ₂ SO ₄	1.197	39.1	9.75	"
				1.148	17.8	13.8	"
				1.116	0.0	20.6	"
Results at 25°				Results at 100°			
—	37.3	0.0	KNO ₃	1.573	242.	2.85	KNO ₃ +K ₂ SO ₄
1.205	36.4	4.67	"	1.566	237.3	2.75	K ₂ SO ₄
1.210	35.7	5.86	" + K ₂ SO ₄	1.567	237.4	2.80	"
1.199	32.4	6.06	K ₂ SO ₄	1.497	182.0	3.49	"
1.170	25.0	6.78	"	1.467	162.3	3.31	"
1.144	18.0	7.78	"	1.394	120.6	4.85	"
1.115	10.3	9.09	"	1.353	101.0	5.60	"
1.086	—	12.10	"	1.229	50.4	9.46	"
				1.163	25.3	14.0	"
Result at 30°				1.119	0.0	24.1	"
1.234	43.4	5.53	KNO ₃ +K ₂ SO ₄				

POTASSIUM NITRATE

SOLUBILITY OF POTASSIUM NITRATE IN AQUEOUS SOLUTIONS
OF POTASSIUM SULFATE AND VICE VERSA.

(Jänecke, 1929.)

The results are expressed in terms of number of gram molecules of H_2O required to dissolve 100 gm. mols. of salt or salt mixture of determined molecular composition.

Mol. % KNO_3 in dissolved salt mixture	M. Mols. H_2O to dissolve 100 gm. mols. salt mixture	Solid Phase	Mol. % KNO_3 in dissolved salt mixture	M. Mols. H_2O to dissolve 100 gm. mols. salt mixture	Solid Phase
Results at 0°			Results at 25° (con.)		
0	1185	$K_2(SO_4)_4$	80	250	K_2SO_4
20	975	"	85	245	" + KNO_3
40	750	"	100	270	KNO_3
60	530	"	Results at 50°		
64	520	" + KNO_3	0	528	K_2SO_4
80	630	KNO_3	20	455	"
100	760	"	40	370	"
Results at 25°			60	280	"
0	722	$K_2(SO_4)_4$	80	190	"
20	625	"	95	110	" + KNO_3
40	520	"	100	112	KNO_3
60	380	"			

Results are also given for the reciprocal salt pair $KNO_3 + (NH_4)_2SO_4 \rightleftharpoons K_2SO_4 + 2NH_4NO_3$.

EQUILIBRIUM IN SYSTEMS COMPOSED OF POTASSIUM AND SODIUM
CHLORIDES, NITRATES AND SULFATES.

Complete experimental data, including densities, in the form of tabular results and diagrams for these complex systems at temperatures between 0° and 90° are given by Cornec and Krombach, 1929, and Cornec, Krombach and Spack, 1930. These authors have made use whenever necessary of the results for the ternary systems and quaternary systems previously reported from their own laboratory or by others, including Chretien, 1929; Cornec and Hering, 1925-7; Cornec and Krombach, 1929; Meyerhoffer and Saunders, 1899; D'Ans, 1915 and Blasdale, 1918.

SOLUBILITY OF POTASSIUM NITRATE IN AQUEOUS SOLUTIONS
OF MAGNESIUM NITRATE AND VICE VERSA.

(Benrath and Benrath, 1929(a), 1930; Benrath and Sichelschmidt, 1931.)

d. of sat. sol.	Gms. per 100 gms. sat. sol.		Solid Phase
	$\text{Mg}(\text{NO}_3)_2$	KNO_3	
Results at 0°			
1.079	0.0	11.7	KNO_3
1.091	2.26	11.5	"
1.106	5.45	8.35	"
1.146	11.06	6.48	"
1.174	17.55	4.29	"
1.296	27.29	4.35	"
1.350	33.42	4.40	" + $\text{Mg}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$
1.389	37.6	3.26	$\text{Mg}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$
1.382	38.45	1.09	"
1.369	38.58	0.0	"
Results at 25°			
1.194	0.0	27.49	KNO_3
1.202	5.98	21.40	"
1.221	10.06	17.84	"
1.265	18.73	12.41	"
1.320	26.09	10.18	"
1.438	37.2	8.63	$\text{Mg}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$
1.462	39.3	7.67	"
1.431	40.49	3.98	"
1.394	42.0	0.0	"
Results at 50°			
1.315	0.0	46.10	KNO_3
1.318	4.44	39.37	"
1.316	14.12	28.36	"
1.361	26.18	19.36	"
1.455	35.86	15.45	KNO_3
1.459	37.03	15.40	"
1.505	40.47	15.02	" + $\text{Mg}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$
1.462	42.50	8.32	$\text{Mg}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$
1.416	45.44	0.0	"
Results at 75°			
1.470	0.0	60.53	KNO_3
1.445	3.78	54.17	"
1.432	13.52	40.68	"
1.426	23.30	30.76	"
1.510	34.07	24.04	"
1.510	40.41	22.30	"
1.645	44.58	22.00	" + $\text{Mg}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$
1.599	45.69	16.96	$\text{Mg}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$
1.537	48.01	10.15	"
1.461	51.00	0.0	"
Results at 99.5°			
1.529	0.0	70.8	KNO_3
1.532	12.14	54.52	"
1.555	23.19	42.90	"
1.672	37.93	32.05	"
1.690	38.46	30.93	"

NO

Results are also given for the reciprocal salt pair $(\text{KNO}_3)_2 + \text{MgSO}_4 \rightleftharpoons \text{Mg}(\text{NO}_3)_2 + \text{K}_2\text{SO}_4$.

SOLUBILITY OF POTASSIUM NITRATE IN AQUEOUS SOLUTIONS
OF AMMONIA AT 0°.

(Gayer, Bieler and Schmid, 1934.)

The authors present their results in the form of diagrams but do not give their experimental determinations. The following approximate values have been estimated from the published diagram.

Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase
NH ₃	KNO ₃		NH ₃	KNO ₃	
0.0	12.0	KNO ₃	60	8.5	KNO ₃
10.0	8.0	"	70	10.5	"
20.0	5.0	"	80	13.0	"
30.0	3.5	"	86	13.5	"
40.0	5.0	"	90	13.0	"
50.0	7.0	"	100	9.5	"

SOLUBILITY OF POTASSIUM NITRATE IN LIQUID AMMONIA.

t°	d. of sat. sol.	Gms. KNO ₃ per 100 gms. sat. sol.		Authority
			NH ₃	
0.0	—	9.52	10.52	(Linhard and Stephan, 1933, 1934.)
0.1	0.695	9.7	10.74	(Schattenstein and Monosohn, 1932.)
25.0	—	9.42	10.4	(Hunt, 1932.)

THE SYSTEM AMMONIUM NITRATE + POTASSIUM NITRATE + WATER AT 25°.
(Ando, 1925.)

Saturation was obtained by constant rotation in a thermostat. The salts form two series of solid solutions with a gap.

Gms. per 100 gms. sat. sol.		Solid Phase.	Gms. per 100 gms. sat. sol.		Solid Phase.
NH ₄ NO ₃	KNO ₃		NH ₄ NO ₃	KNO ₃	
67.70	0.0	Solid solutions of NH ₄ NO ₃ saturated with KNO ₃	51.56	16.69	KNO ₃ + NH ₄ NO ₃
65.63	2.71		51.16	16.90	"
61.41	7.26		49.45	19.27	Solid solutions of KNO ₃ saturated with NH ₄ NO ₃
59.93	8.62		25.56	21.38	
54.80	13.95		13.48	23.53	

Similar, but apparently less accurate results, determined at the ordinary temperature, are given by Caillart, 1918.

Very complete data for the complex system KNO₃ + NH₄NO₃ + H₂O, in which several modifications of the mix crystals (solid solutions) of the two salts are formed, are given by Jänecke, 1928, and very much more complete results by Jänecke, Hamacher and Rahlfs, 1932. These authors made more than 300 solubility determinations, including analyses of both the saturated solutions and solid phases. The results are presented in the form of tables of experimental determinations and diagrams which show the limits of composition and fields of existence of each of the several modifications of the mix crystals as well as the corresponding compositions of the saturated solutions at temperatures between -15° and +150°.

Data for the mix crystals, solutions and melts in the System (K, NH₄), (Cl, NO₃) are given by Jänecke, 1928.)

SOLUBILITY OF AMMONIUM AND POTASSIUM NITRATES AND SULFATES
IN WATER AT 25°. (Osaka and Inouye, 1925.)

Mixtures of the salts in roughly calculated proportions were rotated in a thermostat for several days, and both the saturated solutions and the solid phases were analyzed. There are five series of solid solutions present as solid phases. These are

1. $(\text{NH}_4, \text{K})_2\text{SO}_4$; 2. $(\text{NH}_4, \text{K})_2(\text{NO}_3)_2\alpha$; 3. $(\text{NH}_4, \text{K})_2(\text{NO}_3)_2\beta$;
4. $(\text{NH}_4, \text{K})_{2.0.5}\text{SO}_4_{0.5}(\text{NO}_3)_2$; 5. $(\text{NH}_4, \text{K})_{2.0.4}\text{SO}_4_{0.6}(\text{NO}_3)_2$.

Complete tables showing the composition of the liquid and solid phases for each of the five series of solid solutions are given. The results are presented in gram percentages, and in molal proportion according to the formula



SOLUBILITY OF MIXTURES OF POTASSIUM NITRATE AND SODIUM
CHLORIDE IN WATER.

(Etard — Ann. chim. phys. [7] 3, 283, '94; the older determinations of Rüdorff, Karsten, Mulder, etc., agree well with those of Etard.)

t°.	Gms. per 100 Gms. Solution.		t°.	Gms. per 100 Gms. Solution.		t°.	Gms. per 100 Gms. Solution.	
	KNO ₃ .	NaCl.		KNO ₃ .	NaCl.		KNO ₃ .	NaCl.
0	13	24	40	30.5	19	120	73	8.0
10	16	23	50	36	17	140	77	7.0
20	20	22	60	42.5	15	160	79.5	6.0
25	23	21.5	80	55	12	170	80.5	5.5
30	25	20.5	100	67	9.5			

NO

100 gms. H_2O , simultaneously sat. with potassium nitrate and sodium chloride, contain 41.14 gms. KNO_3 + 38.53 gms. NaCl at 25° and 168.8 gms. KNO_3 + 39.81 gms. NaCl at 80°. (Soch, 1898.)

SOLUBILITY OF POTASSIUM NITRATE IN AQUEOUS SOLUTIONS OF SODIUM
CHLORIDE AND VICE VERSA. (Leather and Mukerji, 1913.)

Results at 20°.				Results at 30°.			
Sp. Gr. Sat. Sol.	Gms. per 100 Gms. H_2O .		Solid Phase.	Sp. Gr. Sat. Sol.	Gms. per 100 Gms. H_2O .		Solid Phase.
	KNO ₃ .	NaCl.			KNO ₃ .	NaCl.	
I. 167	31.49	0	KNO ₃	I. 261	46.48	9.82	KNO ₃
I. 220	33.41	9.94	"	I. 302	47.08	20.18	"
I. 267	34.93	19.44	"	I. 343	47.24	29.86	"
I. 311	36.41	29.46	"	I. 372	49.24	38.72	" + NaCl
I. 344	37.30	37.73	" + NaCl	I. 342	38.36	38.55	NaCl
I. 330	31.41	37.57	NaCl	I. 298	25.32	38.23	"
I. 283	19.56	37.51	"	I. 258	12.15	37.38	"
I. 243	9.76	36.73	"	I. 202	...	36.30	"
Results at 40°.				Results at 91°.			
I. 288	64.74	0	KNO ₃	I. 552	202.8	0	KNO ₃
I. 320	64.66	11.32	"	I. 573	204.2	12.81	"
...	64.05	23.41	"	I. 601	208.1	28.45	"
I. 396	64.13	35.08	"	I. 645	213.3	37.92	"
I. 411	64.77	38.79	" + NaCl	I. 660	218.8	39.08	" + NaCl
I. 376	52.81	39.51	NaCl	I. 607	175.8	40.87	NaCl
I. 323	34.98	38.98	"	I. 517	126.9	44.33	"
I. 267	17.33	37.74	"	I. 378	57.53	42.90	"

At the higher temperatures, results for NaNO_3 in certain solutions are reported.

KALIUM

844

SOLUBILITY OF POTASSIUM NITRATE IN AQUEOUS SOLUTIONS OF SODIUM NITRATE AND VICE VERSA. (Leather and Mukerji, 1913.)

Results at 30°.			Results at 40°.			Results at 91°.		
Sp. Gr.	Gms. per 100 Gms. H ₂ O.	Gms.	Sp. Gr.	Gms. per 100 Gms. H ₂ O.	Gms.	Sp. Gr.	Gms. per 100 Gms. H ₂ O.	Solid Phase in Each Case.
Sat. Sol.	KNO ₃ .	NaNO ₃ .	Sat. Sol.	KNO ₃ .	NaNO ₃ .	Sat. Sol.	KNO ₃ .	NaNO ₃ .
1.317	45.73	25.00	1.358	63.21	23.85	1.615	200.8	43.4 KNO ₃
1.403	47.25	52.53	1.428	63.86	49.79	1.674	207.2	92.90 "
1.472	50.93	79.27	1.505	66.44	79.46	1.751	229.5	156.2 "
1.544	54.34	103.3	1.570	74.06	116.2	1.790	251.8	206.5 " + NaNO ₃
1.520	47.67	103.1	1.573	68.72	116.7	1.774	211.7	200 NaNO ₃
1.481	30.25	101.6	1.526	43.92	112.2	1.695	128.5	186 "
1.451	14.30	99.10	1.476	20.33	109.9	1.610	55.75	173.1 "
1.406	0	95.90	1.421	0	105.2	1.521	0	160.8 "

Results at 20° are also given.

SOLUBILITY OF POTASSIUM NITRATE IN AQUEOUS SOLUTIONS OF SODIUM NITRATE AND VICE VERSA AT 20°.

(Carnelly and Thomson — J. Ch. Soc. 53, 782, '88; Nicol — Phil. Mag. 31, 360, '91.)

KNO₃ in Aq. NaNO₃ Solutions. NaNO₃ in Aq. KNO₃ Solutions.

Grams per 100 Grams H ₂ O.		Grams per 100 Grams H ₂ O.	
NaNO ₃ .	KNO ₃	KNO ₃ .	NaNO ₃ .
0	31.6	0	88
10	30.5	10	90
20	31.0	20	92
40	33.0	25	93
60	35.5	30	94
80	41.0	35	96

SOLUBILITY OF POTASSIUM NITRATE IN AQUEOUS SOLUTIONS OF SODIUM NITRATE AND VICE VERSA AT 10° AND AT 24.2°.

(Kremann and Zitek, 1909.)

t°.	Gms. per 100 Gms. H ₂ O.	Solid Phase.	t°.	Gms. per 100 Gms. H ₂ O.	Solid Phase.
	KNO ₃ .	NaNO ₃ .		KNO ₃ .	NaNO ₃ .
10	208.9	0	24.2	422	931.3
10	301.9	848.3	24.2	437	1019
10	0	805	24.2	123.6	910.6
24.2	377.3	0	24.2	0	913
24.2	390	346.7			

SOLUBILITY OF MIXTURES OF POTASSIUM NITRATE, SODIUM CHLORIDE AND SODIUM NITRATE IN WATER.

(Cornec and Krombach, 1909.)

t°	d. of sat. sol.	Gms. per 100 gms. H ₂ O			Solid Phase
		KNO ₃	NaCl	NaNO ₃	
0	1.384	16.4	28.4	39.6	KNO ₃ + NaCl + NaNO ₃
5	—	19.7	27.4	44.1	" " "
20	—	34.0	24.3	58.6	" " "
25	1.475	40.3	23.5	64.3	" " "
40	—	66.7	20.8	82.7	" " "
50	1.585	90.3	19.3	96.9	" " "
60	—	119.7	18.3	114.1	" " "
75	1.695	176.0	17.5	145.0	" " "
80	—	200.5	17.6	158.1	" " "
87.5	1.750	241.5	18.0	179.5	" " "
100	1.790	277.6	10.6	222.6	" " "

SOLUBILITY OF POTASSIUM NITRATE IN AQUEOUS SOLUTIONS
OF SODIUM NITRATE AND VICE VERSA.

(Cornec and Krombach, 1929.)

d. of sat. sol.	Gms. per 100 gms. sat. sol.		Solid Phase	d. of sat. sol.	Gms. per 100 gms. sat. sol.		Solid Phase
	NaNO ₃	KNO ₃			NaNO ₃	KNO ₃	
Results at 0°				Results at 75°			
—	0.0	11.7	KNO ₃	1.462	0.0	60.4	KNO ₃
1.422	39.0	10.4	" + NaNO ₃	1.545	18.7	47.7	"
1.352	42.3	0.0	NaNO ₃	1.635	31.3	41.5	"
				1.700	38.3	39.1	" + NaNO ₃
				1.644	42.4	30.9	NaNO ₃
				1.568	49.0	18.0	"
				1.469	58.7	0.0	"
Results at 25°				Results at 87.5°			
1.189	0.0	27.7	KNO ₃	—	0.0	66.2	KNO ₃
1.512	40.3	19.1	" + NaNO ₃	1.746	37.3	43.9	" + NaNO ₃
1.391	47.9	0.0	NaNO ₃	—	61.2	0.0	NaNO ₃
Results at 50°				Results at 100°			
1.332	0.0	46.2	KNO ₃	1.569	0.0	70.9	KNO ₃
1.434	19.1	35.9	"	1.658	18.7	57.7	"
1.529	31.7	31.3	"	1.744	29.7	51.4	"
1.602	39.8	28.9	" + NaNO ₃	1.793	36.7	48.1	" + NaNO ₃
1.557	43.3	21.6	NaNO ₃	1.744	41.1	40.0	NaNO ₃
1.502	47.6	12.3	"	1.647	49.5	25.3	"
1.427	53.2	0.0	"	1.507	63.7	0.0	"
Results at 62.5°							
—	0.0	53.8	KNO ₃				
1.648	38.7	34.3	" + NaNO ₃				
—	56.4	0.0	NaNO ₃				

NO

These authors also give results showing the effect of increasing amounts of sodium chloride upon the solubility of mixtures of potassium nitrate and sodium nitrate. They also give results for the quaternary systems composed of the chlorides, nitrates and sulfates of potassium and sodium at various temperatures.

SOLUBILITY OF POTASSIUM NITRATE IN AQUEOUS SOLUTIONS
OF SODIUM NITRATE AND VICE VERSA.

(Sealowsky and Ettinger, 1935, 1937.)

d. of sat. sol.	Gms. per 100 gms. sat. sol.		Solid Phase	d. of sat. sol.	Gms. per 100 gms. sat. sol.		Solid Phase
	NaNO_3	KNO_3			NaNO_3	KNO_3	
1.	Results at 0°			Results at 40°			
1.085	0.0	12.13	KNO_3	1.250	0.0	39.00	KNO_3
1.424	39.22	10.53	" + NaNO_3	—	39.70	24.60	" + NaNO_3
1.348	42.77	0.0	NaNO_3	1.441	51.20	0.0	NaNO_3
	Results at 20°			Results at 60°			
1.162	0.0	24.13	KNO_3	1.343	0.0	52.0	KNO_3
1.494	42.03	17.13	" + NaNO_3	—	38.13	33.05	" + NaNO_3
—	40.38	16.41	"	1.467	55.50	0.0	NaNO_3
1.406	46.27	0.0	NaNO_3				

Results are also given for the quaternary mixtures in the system composed of $\text{KNO}_3 + \text{NaNO}_3 + \text{Al}(\text{NO}_3)_3 + \text{H}_2\text{O}$ at temperatures between 0° and 60°.

SOLUBILITY OF MIXTURES OF POTASSIUM AND SODIUM NITRATES IN
AQUEOUS SOLUTIONS OF NITRIC ACID AT 25°.
(Nikolajew, 1929.)

Gms. per 100 gms. sat. sol.			Solid Phase	Gms. per 100 gms. sat. sol.			Solid Phase
HNO ₃	KNO ₃	NaNO ₃		HNO ₃	KNO ₃	NaNO ₃	
0	19.7	40.25	KNO ₃ + NaNO ₃	38.98	16.74	7.15	KNO ₃ ·2HNO ₃ + NaNO ₃
5.20	17.68	35.26	"	42.61	11.68	5.75	"
10.66	16.04	30.01	"	54.04	6.52	4.10	"
16.17	15.74	23.64	"	58.62	3.48	3.82	"
21.18	16.06	19.24	"	62.59	1.02	3.32	"
32.65	16.70	11.20	"				

SOLUBILITY OF MIXTURES OF POTASSIUM AND SODIUM NITRATES IN
AQUEOUS SOLUTIONS OF POTASSIUM HYDROXIDE AND OF SODIUM HYDROXIDE AT 25°.
(Nikolajew, 1929.)

Results for Aq. KOH

Results for Aq. NaOH

Gms. per 100 gms. sat. sol.			Solid Phase	Gms. per 100 gms. sat. sol.			Solid Phase
KOH	KNO ₃	NaNO ₃		KOH	KNO ₃	NaNO ₃	
0.0	19.17	40.25	KNO ₃ + NaNO ₃	1.17	16.60	38.70	KNO ₃ + NaNO ₃
1.19	15.65	41.57	"	4.33	13.84	35.75	"
2.84	10.48	43.00	"	7.04	11.46	32.68	"
4.58	6.86	43.22	"	8.20	10.56	31.63	"
7.35	3.12	42.48	"	14.75	6.47	23.67	"
10.54	0.0	40.40	"	28.53	3.34	10.29	"
				31.87	3.29	7.64	"
				40.43	5.20	3.14	"

EQUILIBRIUM IN THE SYSTEM LEAD NITRATE, POTASSIUM NITRATE AND WATER.
(Glasstone and Saunders, 1923.)

Results at 23°.

Results at 50°.

Results at 100°.

Gms. per 100 gms. sat. sol.		Gms. per 100 gms. sat. sol.		Gms. per 100 gms. sat. sol.		Solid Phase at each temp.
KNO ₃	Ph(NO ₃) ₂	KNO ₃	Ph(NO ₃) ₂	KNO ₃	Ph(NO ₃) ₂	
0.0	37.17	0.0	44.79	0.0	55.65	Ph(NO ₃) ₂
2.75	37.37	5.90	44.44	3.79	53.44	"
4.90	37.95	11.26	44.75	15.98	49.93	"
8.42	39.27	16.16	44.61	36.90	44.5	"
14.73	40.86	19.38	44.38	-	-	"
-	-	27.47	43.45	-	-	"
-	-	30.98	43.05	-	-	"
24.67	41.93	33.14	42.14	-	-	"
24.92	40.99	36.33	42.32	51.24	27.04	" KNO ₃
25.93	28.05	37.69	26.47	71.00	0.0	KNO ₃
26.93	9.24	41.72	12.03	-	-	"
27.03	15.14	45.51	0.00	-	-	"
27.39	0.0	-	-	-	-	"

SOLUBILITY OF POTASSIUM NITRATE IN AQUEOUS SOLUTIONS
OF LEAD NITRATE AND VICE VERSA AT 0°.

(Ehrst, 1932.)

Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase
KNO ₃	Pb(NO ₃) ₂		KNO ₃	Pb(NO ₃) ₂	
12.34	0.0	KNO ₃	14.20	37.37	Pb(NO ₃) ₂
13.67	22.95	"	8.95	32.94	"
14.33	26.05	"	4.15	29.63	"
14.89	36.27	"	0.0	26.66	"
14.86	37.14	" + Pb(NO ₃) ₂			

SOLUBILITY OF POTASSIUM NITRATE IN AQUEOUS SOLUTIONS OF STRONTIUM
NITRATE AND VICE VERSA AT 20° AND AT 40°.

(Findlay, Morgan and Morris, 1914.)

t°.	Gms. per 100 Gms. Sat. Sol.		Solid Phase.	t°.	Gms. per 100 Gms. Sat. Sol.		Solid Phase.
	KNO ₃	Sr(NO ₃) ₂			KNO ₃	Sr(NO ₃) ₂	
20	22.90	5.49	KNO ₃	20	12.65	41.12	Sr(NO ₃) ₂ ·4H ₂ O
20	21.70	9.17	"	20	10	40.70	"
20	21.01	17.10	"	40	30.26	23.70	KNO ₃
20	19.60	31.24	"	40	26.90	38.52	" + Sr(NO ₃) ₂ ·4H ₂ O
20	19.49	34.91	"	40	22.50	40.22	Sr(NO ₃) ₂ ·4H ₂ O
20	19.69	39.56	" + Sr(NO ₃) ₂ ·4H ₂ O	40	11.19	44.19	"
20	17.56	40.37	Sr(NO ₃) ₂ ·4H ₂ O	40	0	47.7	"

1000 gms. H₂O, simultaneously saturated with both salts, contain 552 gms. KNO₃ + 1074 gms. Sr(NO₃)₂ at 25°.

(LeBlanc and Noyes, 1890.)

SOLUBILITY OF MIXED CRYSTALS OF POTASSIUM NITRATE AND THAL-
LIUM NITRATE IN WATER AT 25°.

(Fock.)

Grams per Liter.		Mg. Mols. per Liter.		Mol. per cent in Solution.	Sp. Gr. of Solutions.	Mol. per cent in Solid Phase.
TiNO ₃	KNO ₃	TiNO ₃	KNO ₃			
0.00	351.0	0.0	3468.2	0.00	1.2632	0.00
2.37	329.0	8.9	3251.5	0.43	1.1903	0.08
6.15	332.4	23.1	3285.1	0.70	1.1956	0.20
17.64	333.7	66.3	3298.1	1.97	1.2050	0.57
49.74	333.3	186.9	3294.4	5.37	1.2196	1.78
63.60	321.0	239.0	3172.4	7.01	1.2436	2.19
86.18	330.5	323.8	3265.8	9.02	1.2617	2.77
123.8	428.3	465.2	4232.6	9.90	1.2950	6.00
101.3	245.1	380.6	2423.3	13.58	1.2050	27.04
116.1	0.0	463.1	0.0	100.00	1.0964	93.33
						100.00

SOLUBILITY OF POTASSIUM NITRATE IN AQUEOUS SOLUTIONS
OF URANYL NITRATE AND VICE VERSA AT 25°.

(Colani, 1928.)

Gms. per 100 gms. sat. solution		Solid Phase	Gms. per 100 gms. sat. solution		Solid Phase
UO ₂ (NO ₃) ₂	KNO ₃		UO ₂ (NO ₃) ₂	KNO ₃	
0.0	27.44	KNO ₃	48.65	10.36	KNO ₃
3.16	23.15	"	53.88	10.40	UO ₂ (NO ₃) ₂ ·6H ₂ O
6.46	21.23	"	53.90	9.51	"
9.71	19.94	"	54.21	5.30	"
25.80	12.74	"	54.68	3.36	"
40.60	11.11	"	56.08	0.0	"

SOLUBILITY OF POTASSIUM NITRATE IN AQUEOUS SOLUTIONS
OF METHYL ALCOHOL AT 25°.
(Akerlof and Turck, 1935.)

Wt. % CH_3OH in Aq. Solvent	Gm. Mols. KNO_3 per 1000 gms. Solvent	Wt. % CH_3OH in Aq. Solvent	Gm. Mols. KNO_3 per 1000 gms. Solvent
0.00	3.774	59.94	0.3125
4.98	3.046	70.05	0.1898
9.45	2.503	78.46	0.1123
21.04	1.522	89.45	0.0607
40.30	0.7130		

100 gms. Aq. 50 wt. % Ethyl Alcohol ($\text{C}_2\text{H}_5\text{OH}$) dissolve 3.7 gms. KNO_3
at 20°. (Wright, 1926.)

SOLUBILITY OF POTASSIUM NITRATE IN AQUEOUS ALCOHOL SOLUTIONS
(Gerardin—Ann. chim. phys. [4] 5, 151, '65.)

Grams KNO_3 per 100 Grams Aqueous Alcohol of Sp. Gr.:

t°.	0.9904 = 5.5 Wt. %.	0.9843 = 0.35 Wt. %.	0.9703 = 13.5 Wt. %.	0.9726 = 10.1 Wt. %.	0.9571 = 30 Wt. %.	0.939 = 40 Wt. %.	0.8067 = 60 Wt. %.	0.8429 = 90 Wt. %.
10	17	13	10	7	4.5	3	1	0.2
18	22.5	18.5	14.5	10	6.2	4.5	1.6	0.3
20	24	20	16	11	7.0	5	2	0.3
25	29	24.5	20	13.5	9.0	6.5	2.5	0.4
30	36	30	25	17	11.5	8	3.0	0.5
40	52	43	36	27	16.5	11	4	0.6
50	72	61	50	38	23.0	16	6	0.7
60	93	79	69	52	31.0	21	8	1.1

SOLUBILITY OF POTASSIUM NITRATE IN AQUEOUS ALCOHOL AT 18°
(Bodländer—Z. physik. Ch. 7, 310, '91.)

Sp. Gr. of Solution.	Gms. per 100 cc. Solution.			Sp. Gr. of Solution.	Gms. per 100 cc. Solution.		
	$\text{C}_2\text{H}_5\text{OH}$.	H_2O .	KNO_3 .		$\text{C}_2\text{H}_5\text{OH}$.	H_2O .	KNO_3 .
1.1480	...	89.80	25.0	1.0120	23.33	69.81	8.06
1.1085	3.30	87.44	20.11	0.9935	28.11	64.74	6.50
1.1010	5.24	86.26	18.60	0.9585	37.53	54.21	4.11
1.0805	8.69	83.18	16.18	0.9450	42.98	48.15	3.37
1.0755	9.06	83.10	15.39	0.9050	51.23	27.32	1.95
1.0655	14.08	77.93	14.54	0.8722	61.65	24.74	0.83
1.0490	16.27	76.36	12.27	0.8375	69.60	13.95	0.20
1.0375	19.97	72.93	10.8				

SOLUBILITY OF POTASSIUM NITRATE IN DILUTE ETHYL ALCOHOL AT 25°.
(Armstrong and Eyre, 1910-11.)

Wt. % $\text{C}_2\text{H}_5\text{OH}$ in Solvent.	Gms. KNO_3 per 100 Gms. Sat. Solution.
0	27.77
1.14	26.69

SOLUBILITY OF POTASSIUM NITRATE IN AQUEOUS ALCOHOL AND IN AQUEOUS ACETONE.

(Batnick, 1896.)

In Aqueous Alcohol.			In Aqueous Acetone at 40°.		
Wt. Per cent Alcohol.	Gms. KNO ₃ per 100 Gms. Aq. Alcohol.		Wt. Per cent Acetone.	Gms. KNO ₃ per 100 Gms. Solvent.	
	At 30°.	At 40°.			
0	45.6	64.5	0	64.5	
8.25	32.3	47.1	8.5	51.3	
17	22.4	33.3	16.8	38.9	
25.7	15.1	24.1	25.2	22.8	
35	11.4 (34.4°)	16.7	34.3	24.7	
44.9	7	11.6 (44°)	44.1	17	
54.3	4.5	7.2 (55°)	53.9	11.9	
65	2.7	4.4	64.8	7.2	
75.6	1.3	2 (76.3°)	76	3	
88	0.4	0.6 (88.5°)	87.6	0.7	

100 gms. H₂O saturated with sugar and KNO₃ dissolve 224.7 gms. sugar + 41.9 gms. KNO₃, or 100 gms. of the saturated solution contain 61.36 gms. sugar + 11.45 gms. KNO₃ at 31.25°. (Köhler, 1897.)

SOLUBILITY OF POTASSIUM NITRATE IN AQUEOUS SOLUTIONS OF METHYL ALCOHOL, ETHYL ALCOHOL AND MIXTURES OF THE TWO AT 30°.

(Schreinemakers, 1908-09.)

NO

In Aq. CH ₃ OH.		In Aq. C ₂ H ₅ OH.		In Aq. (CH ₃ OH + C ₂ H ₅ OH)*.	
Gms. per 100 CH ₃ OH.	Gms. Sat. Sol. KNO ₃ .	Gms. per 100 C ₂ H ₅ OH.	Gms. Sat. Sol. KNO ₃ .	Gms. per 100 (CH ₃ OH + C ₂ H ₅ OH)	Gms. Sat. Sol. KNO ₃ .
0	31.3	10.1	20.7	0	31.3
7.8	23.3	23.8	12.1	12.7	18.9
17.3	16.3	32.2	9	29.2	12.8
27.8	11.2	43.1	6.1	41	6.7
38.4	7.7	56.9	3.3	47.8	5.1
57	3.8	76.8	0.88	56.4	3.5
98.58	0.43	92.3	0.15	74.8	1.2

* The mixture contained 51.7% CH₃OH and 48.3% C₂H₅OH.

100 gms. trichlorethylene dissolve 0.01 gm. KNO₃ at 15°. (Wester and Bruins, 1914.)

100 cc. anhydrous hydrazine dissolve 14 gms. KNO₃ at room temp.

(Welsh and Broderson, 1915.)

100 gms. aq. 40 weight % C₂H₅OH, simultaneously saturated with the two salts, dissolve 13.74 gms. KNO₃ + 15.78 gms. NaCl at 25°. (Soch, 1898.)

SOLUBILITY OF POTASSIUM NITRATE IN GLACIAL ACETIC ACID SOLUTIONS OF AMMONIUM CHLORIDE AND OF AMMONIUM NITRATE AT 25°.

(Seward and Humblet, 1939.)

Results for CH₃COOH + NH₄Cl

Gms. per liter		Solid Phase
NH ₄ Cl	KNO ₃	
0.097	2.122	KNO ₃
0.195	2.218	"
0.405	2.464	"
0.653	2.829	"

Results for CH₃COOH + NH₄NO₃

Gms. per liter		Solid Phase
NH ₄ NO ₃	KNO ₃	
0.00	1.848	KNO ₃
0.592	1.919	"
2.035	1.982	"

SOLUBILITY OF POTASSIUM NITRATE IN AQUEOUS SOLUTIONS
OF URETHAN AT 25°.
(Palitsch, 1928, 1929.)

Gm. Mols. per 1000 gms. H ₂ O		Solid Phase	Gm. Mols. per 1000 gms. H ₂ O		Solid Phase
KNO ₃	NH ₂ COONH ₂		KNO ₃	NH ₂ COONH ₂	
3.772	0.0	KNO ₃	1.911	13.35	KNO ₃
3.372	1.1225	"	1.592	27.76	"

RECIPROCAL SOLUBILITY OF POTASSIUM NITRATE AND UREA
DETERMINED BY THE FREEZING-POINT METHOD.
(Howells, 1931.)

t°	Gms. KNO ₃ per 100 gms. Mixture	Solid Phase	t°	Gms. KNO ₃ per 100 gms. Mixture	Solid Phase
151.6	36.90	KNO ₃	110.1	24.6	KNO ₃
136.1	32.64	"	109.5	24.59	" + NH ₂ CONH ₂
139.8	31.09	"	110.9	21.79	NH ₂ (X)NH ₂
129.0 tr. pt.	—	"	115.6	14.75	"
124.9	29.61	"	121.2	8.93	"
120.1	27.79	"	128.9	2.53	"
			132.2 m. pt.	0.0	"

tr. pt. is the point of transition of rhombohedral KNO₃ into rhombic KNO₃

Fusion-point data have been determined for the following mixtures:

KNO ₃ + LiNO ₃	(Corveth, 1898; Harkins and Clark, 1915.)
" + KOH	(Retortille & Moles, 1933.)
" + NH ₄ NO ₃	(Perman and Saunders, 1923; Janecke, 1928.)
" + " + Pb(NO ₃) ₂	(Glass, Laybourn and Madgin, 1932, 1933.)
" + NaNO ₃	(Kagan and Kamyschan, 1932.)
" + NaNO ₂	(Corvetti, 1898; Hissink, 1900; Quartaralli, 1920; Briscoe and Madgin, 1933; Glass, Laybourn and Madgin, 1932, 1933.)
" + " + PbNO ₃	(Laybourn and Madgin, 1932.)
" + " + Sr(NO ₃) ₂	(Harkins and Clark, 1915.)
" + Pb(NO ₃) ₂ + Pb ₃ O ₄	(Freeman, Laybourn and Madgin, 1933.)
" + RbNO ₃	(Puschin and Radolcic, 1937.)
" + Sr(NO ₃) ₂	(Hawkins and Clark, 1915.)
" + TlBr	(Rostkowski, 1929.)
" + TlNO ₃	(Van Ryk, 1899, 1905.)

POTASSIUM OXIDE K₂O

The fusion-points of mixtures of K₂O + V₂O₅ are given by Canneri, 1928.

POTASSIUM HYDROXIDE KOH.

SOLUBILITY IN WATER.
(Pickering, 1893; at 15°, Ferchland, 1902.)

t°.	Gms. KOH per 100 Gms.		Solid Phase.	t°.	Gms. KOH per 100 Gms.		Solid Phase.
	Water.	Solution.			Water.	Solution.	
- 2.2	3.7	3.6	Ice	15	107	51.7	KOH.2H ₂ O
-20.7	22.5	18.4	"	20	112	52.8	"
-65.2	44.5	30.8	"	30	126	55.76	"
-36.2	36.2	26.6	KOH.4H ₂ O	32.5	135	57.44	KOH.2H ₂ O +
-32.7	77.94	43.8	"	50	140	58.33	KOH.H ₂ O
-33	80	44.4	KOH.4H ₂ O + KOH.2H ₂ O	100	178	64.03	KOH.H ₂ O
-23.2	85	45.9	KOH.2H ₂ O	125	213	68.06	"
0	97	49.2	"	143	311.7	75.73	"
10	103	50.7	"				

Sp. Gr. of sat. solution at 15° = 1.5355.

100 gms. sat. solution in H₂O contain 50.48 gms. KOH at 15°. (de Forcrand, 1909.)

100 gms. sat. solution in H₂O contain 53.1 gms. KOH at 15°. (Greenish and Smith, 1901.)

1000 gms. H₂O dissolve 21.2 gm. mols. KOH at 25°. (Axerlef and Short, 1937.)

SOLUBILITY OF POTASSIUM HYDROXIDE IN WATER.
(Holzl, 1937.)

t°	Gms. KOH per 100 gms. sat. sol.	Solid Phase	t°	Gms. KOH per 100 gms. sat. sol.	Solid Phase
0	48.85	KOH.2H ₂ O	40	58.03	KOH.H ₂ O
11.5	51.07	"	65.3	60.36	"
25	54.23	"	80	61.73	"
33	57.53	" + KOH.H ₂ O	100	65.15	"

The original results are given in terms of K₂O

FREEZING-POINTS OF AQUEOUS SOLUTIONS OF POTASSIUM HYDROXIDE.
(Klein and Svanberg, 1920.)

t°.....	- 0.343.	- - 0.875.	- 1.773.
Gms. KOH per 100 cc. sol.....	0.5611	1.403	2.805

SOLUBILITY AND TRANSITION-POINTS OF POTASSIUM HYDROXIDE IN WATER.
(Shibata, Oda and Furukawa, 1932.)

t°	Gms. KOH per 100 gms. sat. sol.	Solid Phase
25	53.1	KOH.2H ₂ O
27.27 tr. pt.	—	KOH.2H ₂ O + KOH.1½H ₂ O
33.43 "	—	KOH.1½H ₂ O + KOH.H ₂ O
37.33 " (unstable)	—	KOH.2H ₂ O + KOH.H ₂ O

Data for the system KOH + NH₃ + H₂O are given by Jänecke, 1933(a). Weighed amounts of the three components were placed in small glass ampules which were then sealed. By warming or cooling these ampules, the upper and lower temperatures were determined at which a solid phase, two liquid layers or a combination of solid and liquid layers appeared or disappeared. The temperatures at which certain of the ampules exploded are also given.

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SOLUBILITY OF POTASSIUM HYDROXIDE IN AQUEOUS SOLUTIONS OF ETHYL ALCOHOL AT 30°. (deWaal, 1910.)

Gms. per 100 Gms. Sat. Sol.			Solid Phase.	Gms. per 100 Gms. Sat. Sol.			Solid Phase.
KOH.	C ₂ H ₅ OH.	H ₂ O.		KOH.	C ₂ H ₅ OH.	H ₂ O.	
55.75	0	44.25	KOH·2H ₂ O	27.07	60.02	2.41	KOH·2H ₂ O
54.81	0.43	44.76	"	27.20	73.01	negative*	"
Two liquid layers are formed here.				26.25	81.05	"	"
31	57.50	11.50	KOH·2H ₂ O				
28.99	65.07	5.94	"				

* Negative on account of reaction $\text{KOH} + \text{C}_2\text{H}_5\text{OH} \rightarrow \text{C}_2\text{H}_5\text{OK} + \text{H}_2\text{O}$

SOLUBILITY OF POTASSIUM HYDROXIDE IN METHYL ALCOHOL AND IN ETHYL ALCOHOL. (Murray, 1920.)

The mixtures were shaken occasionally during about three weeks.

t°	Solvent	Formula	d. of sat. sol.	Gms. KOH per 100:		Normality of sat. sol.
				cc sat. sol.	gms. sat. sol.	
28	Methyl Alcohol	CH ₃ OH	1.14	40.1	15.5	7.19
28	Ethyl Alcohol	C ₂ H ₅ OH	1.04	29.0	27.9	5.17

SOLUBILITY OF POTASSIUM HYDROXIDE IN AQUEOUS SOLUTIONS OF ACETONE AT 0°. (Gibby, 1934.)

The binodal curve was determined by titrating acetone into aqueous KOH solutions until a permanent separation into two layers occurred. The lines,*, were located by means of mixtures which yielded sufficient amounts of the two layers to be used for titrating the KOH in each.

Gms. per 100		Gms. per 100		Gms. per 100		Gms. per 100	
gms. sat. sol.	C ₂ H ₆ O*	gms. sat. sol.	C ₂ H ₆ O*	gms. sat. sol.	KOH	gms. sat. sol.	C ₂ H ₆ O*
0.4	80.1	2.2	55.1	15.1	11.1	25.0	—
0.6	70.1	3.0	50.4	16.2	9.8	27.2	2.0
0.7	70.5	4.4	41.7	17.9	7.8	28.4	1.3
1.7	58.6	4.8	41.1	20.7	5.5	28.8	—
2.0	52.7	8.2	26.6	21.3	5.2	27.9	—
				24.1	—	23.8	0.4

Data for equilibrium in the system potassium hydroxide, phenol, water at 25° are given by van Meurs (1916).

Freezing-point data for KOH + RbOH and KOH + NaOH are given by von Hevesy (1900). Results for KOH + KI are given by Searpa (1915).

POTASSIUM Dihydrogen PHOSPHATE KH₂PO₄

SOLUBILITY OF POTASSIUM DIHYDROGEN PHOSPHATE IN WATER.

(Kazanczy, 1920.)

t°	Gms. KH ₂ PO ₄ per 100 gms. sat. sol.	t°	Gms. KH ₂ PO ₄ per 100 gms. sat. sol.	t°	Gms. KH ₂ PO ₄ per 100 gms. sat. sol.
0	12.88 (12.48)	25	20.04 (20.07)	50	22.00
5	14.00	30	21.90	60	23.40
10	15.50	35	23.65	70	27.05
15	16.87 (16.78)	40	25.10	80	31.30
20	18.45	45	26.90	90	45.50

The results in parenthesis are by Henzel and Gübler, 1929. The earlier results of Muthman and Kunze, 1894; Apfel, 1911; Jancke, 1927, and Askenasy and Nessler, 1930 are not in good agreement with the above, especially at the lower temperatures.

SOLUBILITY OF MONO POTASSIUM PHOSPHATE IN WATER. (Apfel, 1911.)

t°.	Mols. KH_2PO_4 per 1000 gms. sat. sol.	Gms. KH_2PO_4 per 100 gms. sat. sol.	t°.	Mols. KH_2PO_4 per 1000 gms. sat. sol.	Gms. KH_2PO_4 per 100 gms. sat. sol.
0.....	0.77	10.48	50.....	2.15	29.27
7.....	1.465	19.95	70.....	2.693	36.67
25.....	1.48	20.15	83.....	3.08	41.94

SOLUBILITY OF MONO POTASSIUM PHOSPHATE IN AQUEOUS SOLUTIONS OF SALTS
AT 25°. (Apfel, 1911.)

Salt.	Gms. salt per 100 gms. sat. sol.	Gms. KH_2PO_4 per 100 gms. sat. sol.	Salt.	Gms. salt per 100 gms. sat. sol.	Gms. KH_2PO_4 per 100 gms. sat. sol.
None....	0.0	20.15	KNO_3	5.56	16.33
K_2SO_4 ...	1.39	19.46	".....	12.03	14.03
"... 3.13	3.13	18.24	CH_3COOK .	4.91	17.43
"... 6.27	6.27	17.70	".....	9.62	14.43
"... 6.79	6.79	17.02	K_2CO_3	1.66 (3.22?)	23.01
"... 6.27	6.27	16.74	".....	5.74 (11.58?)	31.85

In the case of the solubility in aq. K_2CO_3 carbon dioxide is liberated and the results do not show equilibrium.

SOLUBILITY OF POTASSIUM ACID PHOSPHATE, KH_2PO_4 , H_3PO_4 , IN WATER.
(Parravano and Mieli, 1908.)

Determinations by Synthetic (sealed tube) Method.

t°.	Gms. KH_2PO_4 , H_3PO_4 per 100 Gms. Sat. Sol.	Solid Phase.	t°.	Gms. KH_2PO_4 , H_3PO_4 per 100 Gms. Sat. Sol.	Solid Phase.
-0.6	3.337	Ice	65.2	68.44	KH_2PO_4
-2.5	12.13	"	78	72.43	"
-6.7	20.43	"	87.5	77.6	"
-9.2	36.98	"	105.5	85.0	"
-13 Eutec.	44	" + KH_2PO_4	120 tr. pt.	92.1	" + KH_2PO_4 , H_3PO_4
0 (?)	45.8	KH_2PO_4	135	96.1	KH_2PO_4 , H_3PO_4
+10.9	50.3	"	139	100	

PO

EQUILIBRIUM IN THE SYSTEM POTASSIUM OXIDE, PHOSPHORUS
PENTOXIDE AND WATER AT 0° AND AT 25°.

(Jänecke, 1927.)

The results are presented in terms of Gms. of H_2O required to dissolve 100 gms. of mixtures of K_2O + P_2O_5 containing determined percentages of K_2O .

Percent K_2O in dissolved K_2O + P_2O_5	Gms. H_2O required to dissolve 100 gms. K_2O + P_2O_5 at:		Percent K_2O in dissolved K_2O + P_2O_5	Gms. H_2O required to dissolve 100 gms. K_2O + P_2O_5 at:	
	0°	25°		0°	25°
2.4	73.5	47.8	58.5	82.0	82.0
10.0	44.0	44.0	61.0	104.0	80.2
13.1	131.0	92.0	63.9	147.0	101.5
19.5	80	58.0	66.5	152.0	117.5
24.7	172.0	121.0	68.5	153.0	119.0
25.0	63.0	59.0	70.8	160.0	118.0
30.0	260.0	185.0	73.5	153.0	119.0
33.0	280.0	249.0	76.3	153.0	119.0
39.8	460.0	435.0	79.5	171.0	131.0
48.3	363.0	292.0	82.2	173.0	130.0
50.5	210.0	150.0	86.5	156.0	122.0

The diagram drawn from the above results showed the existence in the strongly alkaline solutions of the hitherto unknown $K_3PO_4 \cdot 8H_2O$. This salt was obtained in pure form and its solubility in water determined with the following results.

t°	Gms. K_3PO_4 per 100 gms. sat. solution
7.5	44.2
23.3	49.0
43.3	57.0
45.1	59.7

SOLUBILITY OF POTASSIUM ACID PHOSPHATE, $KH_2PO_4 \cdot H_3PO_4$, IN ANHYDROUS PHOSPHORIC ACID.
(Parravano and Michi, 1908)

Determinations by Synthetic (sealed tube) Method.

t°	Gms. per 100 Gms. Sat. Solution. $\frac{KH_2PO_4 \cdot H_3PO_4}{- KH_2PO_4}$	
38.5	18.17	10.56
84	58.42	33.97
110	77.53	45.08
126.5	92.26	51.90

EQUILIBRIUM IN THE SYSTEM POTASSIUM HYDROXIDE, PHOSPHORIC ACID, WATER AT 25° .

(D'Ans and Schreiner, 1910a; Parker, 1914)

The results of these investigators agree satisfactorily when plotted on cross-section paper. The following figures were read from the curves. Some uncertainty exists in regard to the solid phase in contact with some of the solutions.

Mols. per 1000 Gms. Sat. Sol.		Solid Phase.	Mols. per 1000 Gms. Sat. Sol.		Solid Phase.
K.	PO_4		K.	PO_4	
9.62	0	$KOH \cdot 2H_2O$	7	4	$K_3PO_4 + K_2HPO_4$
9.76	0.24	" + $K_3PO_4 \cdot 3H_2O$	6	3.6	K_2HPO_4
9.15	0.5	$K_3PO_4 \cdot 3H_2O$	5	3.15	"
8.2	1	"	4	2.65	" or $KH_2PO_4(?)$
7.5	1.5	"	3	2.2	" " (?)
8.2	2	"	2	1.7	" " (?)
7.5	2.5	"	1.5	1.5	" " (?)
8.8	2.9	"	1.6	2	KH_2PO_4
9.7	2.9	" + K_3PO_4	2.1	4	"
9.5	3	K_3PO_4	2.5	6	"
8.5	3.4	"	3	8	"
8	3.6	"	1.65	6	$KH_2PO_4 \cdot H_3PO_4$ (Parker)
7.5	3.75	"	1.35	8	" "

Fusion-point data for $KPO_3 + K_4P_2O_7$ are given by Parravano and Calcagni (1908, 1910).

EQUILIBRIUM IN THE SYSTEM POTASSIUM DIHYDROGEN PHOSPHATE
AMMONIUM DIHYDROGEN PHOSPHATE AND WATER AT 0°.

(Askenasy and Nessler, 1930.)

This pair of salts form a continuous series of mix-crystals. The results are expressed in accordance with the terms adopted by Janecke. Additional results for the quarternary system $(K, NH_4)(Cl, H_2PO_4) + H_2O$ are also given.

d.of sat.	Mols. KH_2PO_4 per 100 mols. of dissolved	Mols. H_2O to dissolve 100 mols. of $KH_2PO_4 + NH_4H_2PO_4$	Mol. Percent KH_2PO_4 in the Mix-Crystals form- ing the Solid Phase
sol.	$KH_2PO_4 + NH_4H_2PO_4$	$KH_2PO_4 + NH_4H_2PO_4$	
1.1043	0.0	2815	0.0
1.1312	12.4	2450	6.5
1.1350	15.3	2350	9.0
1.1447	18.2	2280	13.2
1.1568	26.4	2200	23.2
1.1574	31.2	2130	30.7
1.1611	35.2	2105	35.9
1.1604	36.4	2120	42.4
1.1603	38.1	2130	48.8
1.1571	44.2	2240	71.1
1.1577	49.3	2325	81.9
1.1472	54.7	2540	87.8
1.1393	67.4	2950	94.5
1.1169	80.6	3400	96.7
1.1151	100.0	4125	100.0

Additional data for the solubility of mixtures of various Potassium and Ammonium Phosphates in Water at 0° and 25° are given by Janecke, 1927. Attention was directed particularly to the system $K_2PO_4 + NH_4H_2PO_4 + H_2O$ in which the following solid phases occur at either 0° or 25°: $K_2PO_4 \cdot 8H_2O$, K_2HPO_4 , $(NH_4)_2PO_4 \cdot 3H_2O$, $(NH_4)_2HPO_4$, KH_2PO_4 and $NH_4H_2PO_4$. The determinations were made by the synthetic method. The solid phases were identified by the polarization microscope. Nine binary mixtures composed of the three potassium and three ammonium salts were studied. The results however are given in an abridged form chosen to show the most important features of the system.

SOLUBILITY OF POTASSIUM DIHYDROGEN PHOSPHATE IN AQUEOUS
SOLUTIONS OF HYDROGEN PEROXIDE AT 0°.

(Menzel and Gähler, 1929.)

Gms. per 100 gms. sat. sol.	
H_2O_2	KH_2PO_4
0.0	12.48
6.590	16.07
8.242	18.67

SOLUBILITY OF POTASSIUM DIHYDROGEN PHOSPHATE IN
AQUEOUS SOLUTIONS OF URETHAN AT 25°.

(Palitzsch, 1925, 1927)

Gm. Mols. per 1000 gms. H_2O		Solid Phase
KH_2PO_4	$NH_2COOC_2H_5$	
1.82	0.0	KH_2PO_4
1.29	1.235	"
0.75	5.401	"
0.139	32.25	"

POTASSIUM HYPOPHOSPHATE, etc.

SOLUBILITY IN WATER.

(Salzer — Liebigs Ann. 211, 1, 82.)

Salt.	Formula.	Gms. Salt per 100 Gms. H ₂ O.	
		Cold.	Hot.
Potassium Hypophosphate	$K_3P_2O_6 \cdot 8H_2O$	400	...
" Hydrogen Hypophosphate	$K_3HP_2O_6 \cdot 3H_2O$	200	...
" Di Hydrogen Hypophosphate	$K_2H_2P_2O_6 \cdot 3H_2O$	33	100
" Tri Hydrogen Hypophosphate	$KH_3P_2O_6$	66.6	200
" Penta Hydrogen Hypophosphate	$K_3H_5(P_2O_6)_2 \cdot 2H_2O$	40	125
" Hydrogen Phosphite	KH_2PO_3	172 (20°)	...
" Hypophosphite	KH_2PO_2	200 (25°)	333
" Hypophosphite	$KH_2PO_2^*$	14.3 (25°)	28

* Solvent alcohol.

POTASSIUM PERRHENATE $KReO_4$.

SOLUBILITY OF POTASSIUM PERRHENATE IN WATER.

(Hülemann and Kleese, 1936.)

The previous determinations, at temperatures up to 100°, by Puschkin and Kovac, 1931; Lewino, Noddack and Noddack, 1931; and Roth and Becker, 1932, although varying among themselves, give, when plotted, average values which agree closely with the present very careful determinations. The determinations above 100° were made by the synthetic method. The solid phase is $KReO_4$ in all cases.

t°	d. of sat. solution	Gms. $KReO_4$ per 100 gms. sat. sol.	t°	Gms. $KReO_4$ per 100 gms. sat. sol.	t°	Gms. $KReO_4$ per 100 gms. sat. sol.
-0.06 (Eutec)		0.34	109	12.6	366	84.6
+10.5	1.0028	0.62	112	14.0	401	89.3
25.0	1.0067	1.19	154	26.3	445	94.4
50	1.0128	3.19	194	36.7	456	95.4
60	1.0210	4.38	220	50.7	470	96.8
75	1.0303	6.95	239	59.9	498	97.4
85	1.0412	8.98	290	71.9	518 m.pt.	100.
99	1.060	12.20	335	80.1		

1 liter 89.7 Wt. percent Ethyl Alcohol, C_2H_5OH , dissolve 0.302 gm. $KReO_4$ at 18.5°. (Tallert, 1932.)

POTASSIUM SULFIDE K_2S .

Fusion-point data are given for the following systems:

 $K_2S + K_2SO_4$ (Garibeau, Kolb and Kroll, 1938.) $K_2S + S^*$ (Thomas and Rule, 1917; Pearson and Robinson, 1931.)**POTASSIUM Antimony SULFIDE** $K_3SbS_4 \cdot 5H_2O$.**POTASSIUM SulfoANTIMONATE** $K_3SbS_4 \cdot 5H_2O$.

SOLUBILITY IN WATER. (Donk, 1908.)

t°.	Gms. K_3SbS_4 per 100 Gms. Sat. Sol.	Solid Phase.	t°.	Gms. K_3SbS_4 per 100 Gms. Sat. Sol.	Solid Phase.
-1.3	9.5	Ice	-34	62	Ice + $K_3SbS_4 \cdot 6H_2O$
-2.6	17.1	"	-10	65.5	$K_3SbS_4 \cdot 6H_2O$
-4	24.2	"	-4.5	69.1	"
-7.2	35.4	"	0	75.4	$K_3SbS_4 \cdot 5H_2O$
-10.6	42.9	"	+10	76.2	"
-13.5	48.8	"	30	75.1	"
-18.5	52.6	"	50	77.7	$K_3SbS_4 \cdot 3H_2O$
-28.8	59.6	"	80	79.2	"

SOLUBILITY OF POTASSIUM SULFOANTIMONATE IN AQ. SOLUTIONS OF
POTASSIUM HYDROXIDE AT 30° AND VICE VERSA.
(Donk, 1908.)

Gms. per 100	Gms. Sat. Sol.	Solid Phase.	Gms. per 100	Gms. Sat. Sol.	Solid Phase.
K_3SbS_4 .	KOH.		K_3SbS_4 .	KOH.	
75	0	$K_3SbS_4 \cdot 5H_2O$	19.8	40.5	K_3SbS_4
68.4	3.4	$K_3SbS_4 \cdot 3H_2O$	11.5	49.9	" + $KOH \cdot 2H_2O$
56.8	11	"	9.4	49.7	$KOH \cdot 2H_2O$
50.9	16.1	K_3SbS_4	0	56.3	"
37.7	25.5	"			

SOLUBILITY OF POTASSIUM SULFOANTIMONATE IN AQ. ETHYL ALCOHOL.
(Donk, 1908.)

Results at 10°.			Results at 30°.		
Gms. per 100	Gms. Sat. Sol.	Solid Phase.	Gms. per 100	Gms. Sat. Sol.	Solid Phase.
K_3SbS_4 .	C_2H_5OH .		K_3SbS_4 .	C_2H_5OH .	
0	94	$K_3SbS_4 \cdot 5H_2O$	0	97	$K_3SbS_4 \cdot 3H_2O$
0	90.5	"			
Two Liquid Layers Formed Here.			Two Liquid Layers Formed Here.		
69.2	0.8	"	75.1	0	"
76.1	0	"			

Composition of the Liquid Layers.

Composition of the Liquid Layers.

Gms. per 100 Gms.				Gms. per 100 Gms.			
Alcoholic Layer.		Aqueous Layer.		Alcoholic Layer.		Aqueous Layer.	
K_3SbS_4 .	C_2H_5OH .	K_3SbS_4 .	C_2H_5OH .	K_3SbS_4 .	C_2H_5OH .	K_3SbS_4 .	C_2H_5OH .
0	85	67.4	1.1	0	93.1	70.5	± 0.5
2.2	54.7	49	3.4	0	85.6	65.2	1.2
4.2	46.9	45.6	3.8	2.2	56.8	47.8	5.7
27.4	16	...	...	8.5	41.1	37.1	9.2
...	...	12.7	31.1				

SOLUBILITY OF POTASSIUM SULFOANTIMONATE IN AQ. METHYL ALCOHOL AT 15°.
(Donk, 1908.)

Composition of the Liquid Layers.

Gms. per 100 Gms.				Gms. per 100 Gms.			
Alcoholic Layer.		Aqueous Layer.		Alcoholic Layer.		Aqueous Layer.	
K_3SbS_4 .	CH_3OH .	Solid Phase.		K_3SbS_4 .	CH_3OH .	K_3SbS_4 .	CH_3OH .
Gms. per 100	Gms. Sat. Sol.			Gms. per 100	Gms. Sat. Sol.	Gms. per 100	Gms. Sat. Sol.
0.5	99.5	K_3SbS_4		5	82.5	62.5	8
0.45	99.5	"		4.9	76.3	...	...
1.5	93.9	"		7	66.9	...	...
1.8	92	"		13.6	54	...	...
Two Liquid Layers Formed Here.				19.1	45.5	...	...
62.7	7.5	$K_3SbS_4 \cdot 9H_2O$		31.1	31.3
68.4	3.5	"		41.1	22.2
75.5	0	"		47.2	18.2
Two Liquid Layers Formed Here.				57.2	11.1
0.5	98.1	"					

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POTASSIUM SULFITE K_2SO_3 .

SOLUBILITY OF POTASSIUM SULFITE IN WATER.

(Førster, Brosche and Norberg-Schultz, 1924.)

The determinations were made with the greatest care. Constant stirring was employed to secure saturation and an atmosphere of hydrogen to prevent oxidation.

t°.	Gms. K_2SO_3 per 100 gms. sat. sol.	Solid Phase.	t°.	Gms. K_2SO_3 per 100 gms. sat. sol.	Solid Phase.
— 1.69.....	5.78	Ice	— 30.....	51.0	K_2SO_3
— 2.71.....	9.20	"	— 15.....	51.3	"
— 4.10.....	13.37	"	— 6.7.....	51.45	"
— 5.74.....	17.57	"	— 3.9.....	51.35	"
— 6.84.....	20.02	"	+ 0.1.....	51.4	"
— 10.88.....	26.70	"	24.0.....	51.37	"
— 14.06.....	30.6	"	30.0.....	51.76	"
— 31.0.....	44.0	"	54.4.....	51.90	"
— 45.5 Eutec.	51.0	" + K_2SO_4	97.2.....	52.88	"

EQUILIBRIUM IN THE SYSTEM POTASSIUM SULFITE, POTASSIUM OXIDE AND WATER.

(Hölzel, 1937.)

SO

t°	Gms. per 100 gms. sat. sol.		Solid Phase	t°	Gms. per 100 gms. sat. sol.		Solid Phase
	K_2O	K_2SO_3			K_2O	K_2SO_4	
0	0.0	47.52	K_2SO_3	40	0.0	50.37	K_2SO_3
"	40.71	0.43	" + $KOH \cdot 2H_2O$	"	48.32	0.40	" + $KOH \cdot H_2O$
"	41.01	0.0	$KOH \cdot 2H_2O$	"	48.71	0.0	$KOH \cdot H_2O$
11.5	0.0	48.06	K_2SO_3	65.3	0.0	52.27	K_2SO_3
"	42.41	0.48	" + $KOH \cdot 2H_2O$	"	50.14	0.45	" + $KOH \cdot H_2O$
"	42.87	0.0	$KOH \cdot 2H_2O$	"	50.65	0.0	$KOH \cdot H_2O$
25	0.0	49.01	K_2SO_3	80	0.0	53.15	K_2SO_3
"	45.03	0.47	" + $KOH \cdot 2H_2O$	"	51.50	0.39	" + $KOH \cdot H_2O$
"	45.51	0.0	$KOH \cdot 2H_2O$	"	51.81	0.0	$KOH \cdot H_2O$
33	0.0	49.99	K_2SO_3	100	0.0	55.53	K_2SO_3
"	47.81	0.37	" + $KOH \cdot H_2O$	"	54.29	0.40	" + $KOH \cdot H_2O$
"	48.16	0.0	$KOH \cdot H_2O$ + $KOH \cdot 11H_2O$	"	54.67	0.0	$KOH \cdot H_2O$
"	48.29	0.0	" + $KOH \cdot 2H_2O$				

EQUILIBRIUM IN THE SYSTEM POTASSIUM SULFITE, SULFUROUS ACID AND WATER.

(Hölzel, 1937.)

t°	Gms. per 100 gms. sat. sol.		Solid Phase	t°	Gms. per 100 gms. sat. sol.		Solid Phase
	H_2SO_3	K_2SO_3			H_2SO_3	K_2SO_3	
0				40	2.64	53.01	K_2SO_3 + $K_2S_2O_5$
0	0.44	50.36	K_2SO_3 + $K_2S_2O_5$ + $2/3H_2O$	65.3	4.37	55.12	"
"	7.49	14.06	$K_2S_2O_5$ + $2/3H_2O$	80	5.48	55.82	"
11.5	1.11	50.96	K_2SO_3 + $K_2S_2O_5$	100	7.0	56.60	"
25	1.83	51.92	"				

SOLUBILITY OF POTASSIUM SULFITE IN AQUEOUS SOLUTIONS
OF TERTIARY BUTYL ALCOHOL AT 30°.

(Ginnings and Robbins, 1930.)

Wt. Percent (CH_3) ₃ COH in Aq. Solvent	Gms. K_2SO_3 per 100 gms. sat. sol.	Wt. Percent (CH_3) ₃ COH in Aq. Solvent	Gms. K_2SO_3 per 100 gms. sat. sol.
0.0	51.76	9.1	9.8
0.4	34.2	16.1	5.8
0.9	26.7	18.9	4.8
2.5	17.0	22.2	3.0

POTASSIUM Pyro SULFITE $K_2S_2O_5$ and $K_2S_2O_5 \cdot \frac{2}{3}H_2O$.

KALIUM

SOLUBILITY IN WATER.

(Farster, Brosche and Norberg-Schultz, 1924.)

The numerous determinations of the authors were plotted and the following values read from the curves.

Results for $K_2S_2O_5$.

t°.	Gms. $K_2S_2O_5$ per 100 gms. sat. sol.	Solid Phase.
— 1.07.....	3.73	Ice
— 2.0.....	6.8	"
— 4.0.....	13.8	"
— 5.0.....	17.5	"
— 5.6 Eutec.	19.5	" + $K_2S_2O_5$
— 30.....	20.7	$K_2S_2O_5$
± 0.0.....	22.1	"
+ 2.0.....	22.8	"
10.0.....	26.5	"
20.0.....	30.8	"
25.0.....	32.8	"
30.0.....	34.8	"
40.0.....	39.0	"
50.0.....	42.5	"
60.0.....	46.0	"
80.0.....	51.9	"
94.0.....	55.5	"

Results for $K_2S_2O_5 \cdot \frac{2}{3}H_2O$.

t°.	Gms. $K_2S_2O_5$ per 100 gms. sat. sol.	Solid Phase.
— 1.0.....	4.0	Ice
— 2.0.....	7.5	"
— 4.0.....	13.5	"
— 5.0.....	16.0	"
— 6.0 Eutec.	18.0	" + $K_2S_2O_5 \cdot \frac{2}{3}H_2O$
— 4.0.....	19.2	$K_2S_2O_5 \cdot \frac{2}{3}H_2O$
— 3.0.....	19.9	"
— 2.0.....	20.5	"
— 0.0.....	21.7	"
2.0.....	22.8	"
4.0.....	24.1	"
6.0.....	25.1	"
8.0.....	26.2	"
10.0.....	27.4	"
15.0.....	30.1	"
20.0.....	33.2	"

100 gms. liquid Sulfur Dioxide saturated with Potassium Pyro Sulfite (Meta bi Sulfite), contain 0.035 gm. $K_2S_2O_5$ at 0°. (Jander and Wickert, 1936.)

POTASSIUM Sodium SULFITE $KNa_2H(SO_3)_2 \cdot 4H_2O$.

100 gms. H_2O dissolve 69 gms. of the salt at 15°.

(Schwicker, 1889.)

POTASSIUM SULFATE K_2SO_4 .

SOLUBILITY IN WATER.

(Mulder; Andrae, 1884; Trevor, 1891; Tilden and Shenstone, 1884; Berkeley, 1904; see also Etard, 1891.)

t°.	Gms. K_2SO_4 per 100 Gms.		t°.	Gms. K_2SO_4 per 100 Gms.		t°.	Gms. K_2SO_4 per 100 Gms.	
	Water.	Solution.		Water.	Solution.		Water.	Solution.
0	7.35	6.85	40	14.76	12.86	90	22.8	18.57
10	9.22	8.44	50	16.50	14.16	100	24.1	19.42
20	11.11	10	60	18.17	15.38	120	26.5	20.94
25	12.04	10.75	70	19.75	16.49	143	28.8	22.36
30	12.97	11.48	80	21.4	17.63	170	32.9	24.76

Sp. Gr. of solution saturated at 18° = 1.083.

The determinations of Berkeley (1904), which were made with exceptional care, are as follows:

t°.	Sp. Gr. of Sat. Solution.	Gms. K_2SO_4 per 100 Gms. H_2O .	t°.	Sp. Gr. of Sat. Solution.	Gms. K_2SO_4 per 100 Gms. H_2O .
0.40	1.0589	7.47	58.95	1.1089	18.01
15.70	1.0770	10.37	74.85	1.1157	20.64
31.45	1.0921	13.34	89.70	1.1194	22.80
42.75	1.1010	15.51	101.1 b. pt.	1.1207	24.21

Individual determination in good agreement with the above, are given by Le-Blanc and Schmandt (1911); Greenish and Smith (1901); Osuka (1903-8); Nacken (1910); Smith and Ball (1917).

SOLUBILITY OF POTASSIUM SULFATE IN WATER.

The closely agreeing determinations of Caven and Johnston, 1927, 1928; Wright, 1927; Flöttmann, 1928; Blasdale, 1923; Hill and Moskowitz, 1929; Starrs and Storck, 1930; Malhorta and Suri, 1930; Benrath and Wazelle, 1929; Babajewa, 1913; Rakowski and Babajewa, 1931; Schröder and Schlackmann, 1934; and Benrath, Gjedebo, Schiffrers and Wunderlich, 1937 for temperatures above 100°, were plotted and the following values taken from the average curve.

t°	Gms. K_2SO_4 per 100 gms. sat. sol.	t°	Gms. K_2SO_4 per 100 gms. sat. sol.	t°	Gms. K_2SO_4 per 100 gms. sat. sol.	t°	Gms. K_2SO_4 per 100 gms. sat. sol.
0	6.9	40	12.9	100	19.4	310	23.3
10	8.5	50	14.2	179	25.4	327	16.2
15	9.2	60	15.4	208	25.7	337	12.3
20	10.0	70	16.55	245	25.9	344	8.36
25	10.75	80	17.6	292	26.0	357	3.9
30	11.5	90	18.6				

The densities of the saturated solutions are: 1.0757 at 15°, 1.0807 at 20° and 1.0853 at 25°. (Flöttmann, 1928.)

Data for the Solubility of Potassium Sulfate in Water at 25° and under Pressures up to 10,000 bars (metric atmospheres) are given by Adams, 1932.

EQUILIBRIUM IN THE SYSTEM POTASSIUM SULFATE SULFURIC ACID AND WATER.
(Babajewa, 1931.)

Results at 30° Results at 50° Results at 75°

Gms. per 100 gms. sat. sol.		Gms. per 100 gms. sat. sol.		Gms. per 100 gms. sat. sol.		Solid Phase at each temperature
H_2SO_4	K_2SO_4	H_2SO_4	K_2SO_4	H_2SO_4	K_2SO_4	
0.0	11.50	0.0	14.16	0.0	17.10	K_2SO_4
5.38	15.70	4.92	18.66	6.77	24.27	"
8.75	18.80	7.45	20.09	8.07	25.55	"
11.22	20.80	11.60	26.03	8.96	26.38	"
—	—	14.40	29.61	12.43	31.24	"
12.00	22.00	16.40	32.80	18.03	40.43	" + $K_2SO_4 \cdot KHSO_4$
17.61	22.56	19.37	33.80	18.80	40.81	$K_2SO_4 \cdot KHSO_4$
20.95	22.99	21.49	35.37	21.03	42.76	"
21.20	24.80	22.40	36.40	—	—	" + $K_2SO_4 \cdot 6KHSO_4$
23.49	17.64	23.21	31.66	—	—	$K_2SO_4 \cdot 6KHSO_4$ + $KHSO_4$
—	—	—	—	24.40	46.38	$K_2SO_4 \cdot KHSO_4$ + $KHSO_4$
28.41	10.83	23.73	30.47	25.16	42.82	$KHSO_4$
33.92	6.43	24.42	28.15	26.97	37.27	"
37.38	3.56	27.63	22.03	30.05	28.80	"
52.20	2.18	32.49	14.25	40.00	13.98	"
54.59	2.00	36.80	9.27	54.23	8.88	"
63.16	3.35	43.79	6.34	60.48	9.50	"
68.93	4.84	—	—	—	—	"
—	—	56.13	4.41	—	—	K_X
—	—	63.98	5.75	—	—	$KHSO_4$
—	—	68.08	9.96	—	—	"
75.67	4.12	72.00	19.78	—	—	"
—	—	74.52	13.41	—	—	K_X

K_X is perhaps the hydrate $K_2SO_4 \cdot KHSO_4 \cdot H_2O$.

SOLUBILITY OF POTASSIUM SULFATE IN AQUEOUS SOLUTIONS OF SULFURIC
ACID AT 18°.

(Stortenbecker, 1902.)

Mols. per 100 Mols. $K_2SO_4 + H_2SO_4 + H_2O$.		Solid Phase.	Mols. per 100 Mols. $K_2SO_4 + H_2SO_4 + H_2O$.		Solid Phase.
K_2SO_4 .	H_2SO_4 .		K_2SO_4 .	H_2SO_4 .	
1.10	0	K_2SO_4	2.80	5.79	$K_2SO_4 \cdot 3KHSO_4$
1.59	0.95	"	2.61	5.61	$K_2SO_4 \cdot 6KHSO_4$
2.49	2.70	"	2.25	6.19	" + $KHSO_4$
2.75	3.17	$K_2SO_4 \cdot KHSO_4$	1.08	7.94	$KHSO_4$
2.75	3.74	"	0.77	9.2	"
2.83	5.08	"	0.44	22.7	"

SOLUBILITY OF POTASSIUM SULFATE IN AQUEOUS SOLUTIONS OF SULFURIC
ACID AT 0°.

(D'Ans, 1909a.)

Mols. per 1000 Gms. Sat. Sol.		Solid Phase.	Mols. per 1000 Gms. Sat. Sol.		Solid Phase.
K_2SO_4 .	H_2SO_4 .		K_2SO_4 .	H_2SO_4 .	
0.53	0.37	K_2SO_4	0.61	2.12	$K_a + K_b$
0.64	0.75	"	0.54	2.29	K_b
0.74	1.08	" + $K_2H(SO_4)_2$	0.53	2.30	" + $KHSO_4$
0.73	1.13	$K_2H(SO_4)_2$	0.43	2.48	$KHSO_4$
0.71	1.44	"	0.28	3.04	"
0.69	1.66	"	0.12	4.43	"
0.69	1.88	" + K_a	0.09	5.27	"

K_a and K_b are acid sulfates between $K_2H(SO_4)_2$ and $KHSO_4$. Their compositions were not determined.

SOLUBILITY OF POTASSIUM SULFATE IN AQUEOUS SOLUTIONS OF SULFURIC
ACID AT 25°.

(D'Ans, 1909a, 1913; see also Herz, 1911-12.)

Mols. per 1000 Gms. Sat. Sol.		Solid Phase.	Mols. per 1000 Gms. Sat. Sol.		Solid Phase.
K_2SO_4 .	H_2SO_4 .		K_2SO_4 .	$H_2SO_4 + SO_3$.	
1.27	1.31	$K_2SO_4 + K_2H(SO_4)_2$	0.250	8.10	$KH_2(SO_4)_2 \cdot H_2O$
1.33	1.99	$K_2H(SO_4)_2 + Ky$	0.352	8.15	"
1.24	2.03	Ky	0.364	8.16	" + $KH_2(SO_4)_2$
1.13	2.17	"	0.341	8.29	$KH_2(SO_4)_2$
1.04	2.35	" + $KHSO_4$	0.322	8.33	"
1.032	2.345	$KHSO_4$	0.325	8.45	"
0.67	2.83	"	0.346	6.62	"
0.22	4.13	"	0.384	8.57	"
0.15	5.36	"	0.412	8.71	"
			0.583	8.82	"
K_2SO_4 .	$H_2SO_4 + SO_3$.		0.880	8.65	" + $KHSO_4$
0.171	6.42	$KHSO_4$	0.899	8.63	$KHSO_4$ (unstable)
0.190	6.60	"	0.882	8.70	"
0.266	6.91	" + $KH_2(SO_4)_2 \cdot H_2O$	0.561	8.96	"
0.182	7.26		0.365	9.80	"
0.157	7.62		0.43	9.78	"
0.167	7.88		0.665	9.80	"
0.201	8		0.937	9.66	"

K_y = an acid sulfate between $K_2H(SO_4)_2$ and $KHSO_4$ of which the exact composition was not determined.

K KALIUM

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POTASSIUM BISULFATE KHSO_4

SOLUBILITY OF POTASSIUM BISULFATE IN WATER.
(Kremers, 1854; Platt and Hudson, 1929.)

t°	Gms. KHSO_4 per 100 gms. sat. sol.	t°	Gms. KHSO_4 per 100 gms. sat. sol.	t°	Gms. KHSO_4 per 100 gms. sat. sol.
0	26.6	35	36.6	60	43.3
15	31.3	40	37.9	65	44.6
20	33.7	45	38.2	70	46.1
25	34.0	50	40.3	75	47.8
30	35.4	55	41.7	100	54.9

EQUILIBRIUM IN THE SYSTEM POTASSIUM SULFATE, SODIUM
SULFATE AND SULFURIC ACID AT 12.6° .
(Montemartini and Louana, 1929.)

d. of sat. solution	Gms. per 100 gms. sat. sol.			Solid Phase
	Na_2SO_4	K_2SO_4	K_2SO_4	
1.1862	3.64	13.58	0.0	$3\text{K}_2\text{SO}_4 \cdot \text{Na}_2\text{SO}_4$
1.2680	4.77	17.59	10.96	"
1.3846	10.75	18.84	18.12	$5\text{K}_2\text{SO}_4 \cdot \text{Na}_2\text{SO}_4$
1.4870	14.12	18.34	20.53	" + $\text{K}_2\text{SO}_4 \cdot \text{KHSO}_4 \cdot \text{H}_2\text{O}$ + $\text{Na}_2\text{SO}_4 \cdot \text{NaHSO}_4 \cdot 5\text{H}_2\text{O}$
1.4882	21.84	9.02	23.98	$\text{K}_2\text{SO}_4 \cdot \text{KHSO}_4 \cdot 5\text{H}_2\text{O}$ + $\text{Na}_2\text{SO}_4 \cdot \text{NaHSO}_4 \cdot 5\text{H}_2\text{O}$ + traces of $5\text{K}_2\text{SO}_4 \cdot \text{Na}_2\text{SO}_4$
1.4802	22.86	3.54	29.12	$\text{KHSO}_4 \cdot \text{H}_2\text{O}$ + $\text{NaHSO}_4 \cdot \text{H}_2\text{O}$
1.4126	9.56	1.64	36.88	"
1.4760	3.12	1.02	52.24	"
1.5800	3.54	1.43	60.56	$\text{KHSO}_4 \cdot \text{H}_2\text{SO}_4 \cdot \text{H}_2\text{O}$ + NaHSO_4
1.6642	4.26	2.02	69.96	$\text{KHSO}_4 \cdot \text{H}_2\text{SO}_4$ + $\text{NaHSO}_4 \cdot \text{H}_2\text{SO}_4$
1.7806	5.40	3.02	80.72	"
1.9260	9.30	6.72	83.68	$\text{NaHSO}_4 \cdot \text{KHSO}_4 \cdot 2\text{H}_2\text{SO}_4$

SOLUBILITY OF POTASSIUM SULFATE IN AQUEOUS SOLUTIONS
OF HYDROGEN PEROXIDE AT 25° .
(Akerlof and Turck, 1939.)

Wt. Percent H_2O_2 in Aq. Solvent	M. Mols. K_2SO_4 per 1000 gms. solvent
0.0	0.6905
15.72	1.387
31.43	1.945

SO

SOLUBILITY OF POTASSIUM SULFATE IN AQUEOUS SOLUTIONS OF POTASSIUM CHLORIDE, BROMIDE, AND IODIDE.
(Blarez, 1891.)

Interpolated from the original results.

Grams Halogen Salt per 100 cc. Solution.	Grams K ₂ SO ₄ per 100 cc. in Aq. Solutions of:		
	KCl at 12.5°.	KBr at 14°.	KI at 12.5°.
0	9.9	10.16	9.9
2	8.3	9.1	9.2
4	7.0	8.2	8.4
6	5.7	7.4	7.7
8	4.6	6.6	7.2
10	3.5	6.0	6.6
12	...	5.5	6.0

SOLUBILITY OF POTASSIUM SULFATE IN AQUEOUS SOLUTIONS OF POTASSIUM HYDROXIDE AT 25°.
(D'Ans and Schreiner, 1910.)

Mols. per 1000 Gms. Sat. Solution.		Gms. per 100 Gms. Sat. Solution.		Mols. per 1000 Gms. Sat. Solution.		Gms. per 100 Gms. Sat. Solution.	
(KOH) ₂ .	K ₂ SO ₄ .	KOH.	K ₂ SO ₄ .	(KOH) ₂ .	K ₂ SO ₄ .	KOH.	K ₂ SO ₄ .
0	0.617	0	10.75	2.86	0.035	32.06	0.61
0.258	0.433	2.892	7.544	3.42	0.009	38.33	0.10
0.433	0.280	4.854	4.878	4.809	0	53.51	0
1.13	0.137	12.67	2.386				

SOLUBILITY DATA FOR THE RECIPROCAL SALT PAIR



(Meyerhoffer, 1905.)

t°.	Gms. per 100 Gms. Sat. Sol.		Solid Phase.	t°.	Gms. per 100 Gms. Sat. Sol.		Solid Phase
	K ₂ SO ₄ .	K ₂ CO ₃ .			K ₂ SO ₄ .	K ₂ CO ₃ .	
25	10.76	0	K ₂ SO ₄ + BaSO ₄	25	0.602	7.35	BaCO ₃ + BaSO ₄
25	6.76	5.85	" "	25	0.173	2.85	"
25	3.92	12.6	" "	80	0.613	2.49	"
25	2.485	17.81	" + BaCO ₃	80	1.39	4.88	"
25	1.72	22.1	K ₂ SO ₄ + BaCO ₃	80	7.1	15.33	" + K ₂ CO ₃
25	0.0886	28.5	" "	100	0.797	2.36	BaCO ₃ + BaSO ₄
25	0.023	53.1	" + K ₂ CO ₃ ·2H ₂ O	100	1.83	4.51	" "
25	0	53.2	K ₂ CO ₃ ·2H ₂ O + BaCO ₃	100	9.42	13.6	" + K ₂ SO ₄

SOLUBILITY OF THE THREE HYDRATES OF POTASSIUM FERROSULFATE
IN WATER AT DIFFERENT TEMPERATURES.

(Küster and Thiel, 1899.)

t°.	K ₂ SO ₄ ·FeSO ₄ ·6H ₂ O		cc. N/10 KMnO ₄ per 2 cc. Solution.	K ₂ SO ₄ ·FeSO ₄ ·4H ₂ O		cc. N/10 KMnO ₄ per 2 cc. Solution.	K ₂ SO ₄ ·FeSO ₄ ·2H ₂ O	
	Gms. K ₂ SO ₄ per 100 cc. Sol.	Gms. FeSO ₄ per 100 cc. Sol.		Gms. K ₂ SO ₄ per 100 cc. Sol.	Gms. FeSO ₄ per 100 cc. Sol.		Gms. K ₂ SO ₄ per 100 cc. Sol.	Gms. FeSO ₄ per 100 cc. Sol.
0.5	12.4	18.36	15.5	22.04	15.4	21.79		
17.2	17.0	25.16	18.1	26.79	21.6	31.98		
40.1	24.8	36.72	21.9	32.41	27.6	40.86		
60	29.0	42.93	24.1	35.68	28.8	42.63		
80	30.6	45.29	27.3	40.46	28.6	42.34		
90	...	...	29.6	43.82	28.9	42.73		
95	...	...	29.8	44.11	27.7	41.02		

SOLUBILITY OF POTASSIUM SULFATE IN AQUEOUS SOLUTIONS
OF MAGNESIUM SULFATE AND VICE VERSA AT 25°.

(Van Klooster, 1917.)

Gms. per 100 Gms. Sat. Sol.		Solid Phase.	Gms. per 100 Gms. Sat. Sol.		Solid Phase.
MgSO ₄ .	K ₂ SO ₄ .		MgSO ₄ .	K ₂ SO ₄ .	
26.76	0	MgSO ₄ ·7H ₂ O	13.26	10.34	MgK ₂ (SO ₄) ₂ ·6H ₂ O
26.67	1.68	"	12.88	10.51	"
26.57	2.34	"	12.68	10.70	" + K ₂ SO ₄
26.36	3.76	"	12.06	10.77	K ₂ SO ₄
26.39	4.02	" + MgK ₂ (SO ₄) ₂ ·6H ₂ O	10.69	10.84	"
18.76	7.02	MgK ₂ (SO ₄) ₂ ·6H ₂ O	7.8	11.10	"
16.36	8.43	"	4	11.03	"
14.27	9.63	"	0	10.77	"

SOLUBILITY OF MAGNESIUM SULFATE IN AQUEOUS SOLUTIONS OF POTASSIUM
SULFATE AT 30° AND VICE VERSA. (Weston, 1922.)

Gms. per 100 gms. sat. sol.		Solid Phase.	Gms. per 100 gms. sat. sol.		Solid Phase.
MgSO ₄ .	K ₂ SO ₄ .		MgSO ₄ .	K ₂ SO ₄ .	
29.03	0.0	MgSO ₄ ·7H ₂ O	18.08	8.59	MgSO ₄ ·K ₂ SO ₄ ·6H ₂ O
27.69	3.21	Mixed Crystals	13.19	11.66	"
27.48	4.36	"	12.88	12.47	"
26.20	5.98	"	9.49	12.64	K ₂ SO ₄
26.28	6.60	"	3.45	11.98	"
26.05	6.93	"	0.08	11.20	"

The author also gives data for the quaternary system MgSO₄ + K₂SO₄ + (NH₄)₂SO₄ + H₂O.

EQUILIBRIUM IN THE SYSTEM MAGNESIUM SULFATE, POTASSIUM SULFATE
AND WATER AT VARIOUS TEMPERATURES. (Levi, 1923.)

Gms. per 100 gms. sat. sol.				Gms. per 100 gms. sat. sol.			
t°	MgSO ₄ .	K ₂ SO ₄ .	Solid Phase.	t	MgSO ₄ .	K ₂ SO ₄ .	Solid Phase.
0.0...	21.09	3.42	MgSO ₄ ·12H ₂ O + 1.1.6	34.4...	14.38	11.66	K ₂ SO ₄ + 1.1.6
19.8...	25.34	3.83	MgSO ₄ ·7H ₂ O + "	44.7...	17.00	12.08	" + "
26.1...	26.45	4.26	" + "	49.6...	18.09	12.46	" + ?
37.8...	29.80	4.13	" + "	55.2...	18.38	12.86	" + 1.1.4
60.	8.73	7.86	K ₂ SO ₄ + "	63.4...	17.20	14.35	" + "
20.4 ..	12.08	10.10	" + "				

1.1.6 = Schönite, MgSO₄·K₂SO₄·6H₂O; 1.1.4 = Leonite, MgSO₄·K₂SO₄·4H₂O.

The author considers that the results of Van der Heide are incorrect, due to incomplete saturation. The errors in the data of others are also pointed out.

SOLUBILITY OF POTASSIUM MAGNESIUM SULFATE IN WATER.

(Tobler, 1855.)

t°	Gms. K ₂ Mg(SO ₄) ₂ per 100 gms. H ₂ O	Solid Phase	t°	Gms. K ₂ Mg(SO ₄) ₂ per 100 gms. H ₂ O	Solid Phase
0	14.1	K ₂ SO ₄ ·MgSO ₄ ·6H ₂ O	45	40.5	K ₂ SO ₄ ·MgSO ₄ ·6H ₂ O
20	25.0	"	60	50.2	"
30	30.4	"	75	59.8	"

100 gms. H₂O dissolve 30.52 gms. K₂Mg(SO₄)₂·6H₂O at 15°.
(Lothian, 1909.)

EQUILIBRIUM IN THE SYSTEM POTASSIUM SULFATE, MAGNESIUM
SULFATE AND WATER AT VARIOUS TEMPERATURES.

d. of sat. sol.	Gms. per 100 gms. sat. sol.		Solid Phase
	MgSO_4	K_2SO_4	
Results at 0° (Benrath & Benrath, 1930.)			
1.025	0.0	6.68	K_2SO_4
1.061	1.26	7.03	"
1.108	4.17	7.51	"
1.115	4.59	7.77	" + 1.1.6
1.163	8.60	7.85	1.1.6
1.165	8.94	7.53	"
1.192	11.79	6.76	"
1.265	20.78	3.03	" + $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$
1.271	20.74	7.93*	$\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$
1.274	20.68	4.34*	"
1.259	20.94	2.17	"
1.236	20.82	0.0	"

Results at 25° (Benrath & Benrath, 1929(a))

1.088	0.0	10.75	K_2SO_4
1.123	2.60	10.86	"
1.149	5.05	10.85	"
1.230	12.61	10.99	" + 1.1.6
1.249	14.28	9.89	1.1.6
1.267	17.02	9.18	"
1.294	20.32	7.32	"
1.347	26.02	4.90	" + $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$
1.324	26.61	2.11	$\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$
1.305	26.65	0.0	"

Results at 30° (in terms of gms. per 100 gms. H_2O) (Starrs and Clark, 1930.)

—	0.0	13.11	K_2SO_4
—	4.80	14.24	"
—	12.03	15.26	"
—	16.04	15.32	"
—	17.72	15.33	" + 1.1.6
—	18.51	14.45	1.1.6
—	26.17	11.29	"
—	31.78	8.89	"
—	37.43	7.19	"
—	39.91	6.55	" + $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$
—	39.13	5.53	$\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$
—	39.29	5.79	"
—	39.10	0.0	"

1.1.6 = Schönite, $\text{K}_2\text{SO}_4 \cdot \text{MgSO}_4 \cdot 6\text{H}_2\text{O}$.

Bozza, 1934, also gives a compilation with diagrams of all available data upon this system at temperatures between 0° and 100° calculated to the terms proposed by Janecke.

POTASSIUM SULFATE

EQUILIBRIUM IN THE SYSTEM POTASSIUM SULFATE, MAGNESIUM SULFATE AND WATER AT VARIOUS TEMPERATURES. (Continued.)

d. of sat. sol.	Gms. per 100 gms. sat. sol.		Solid Phase
	MgSO ₄	K ₂ SO ₄	

Results at 35° (Bozza, 1934.)

1.148	5.04	12.40	K ₂ SO ₄
—	7.16	12.28	"
1.242	13.13	11.67	"
1.250	14.40	11.90	" + 1.1.6
—	16.15	10.20	1.1.6
1.283	17.82	9.33	"
1.284	20.37	7.55	"
—	24.60	5.61	"
1.360	28.45	4.35	" + MgSO ₄ ·7H ₂ O
1.336	28.41	1.78	MgSO ₄ ·7H ₂ O
1.332	29.20	0.0	"

Results at 50° (Benrath and Benrath, 1929(a))

1.087	0.0	14.14	K ₂ SO ₄
1.148	5.05	14.13	"
1.255	13.86	13.47	"
1.292	16.96	13.10	" + 1.1.2
1.290	17.36	13.06	1.1.2
1.322	21.88	10.32	"
1.337	24.39	8.14	"
1.370	28.59	5.98	"
1.394	32.35	4.30	" + MgSO ₄ ·6H ₂ O
1.380	32.76	2.60	MgSO ₄ ·6H ₂ O
1.383	33.50	0.0	"

Results at 66° (Benrath and Sienelschmidt, 1931.)

—	0.0	16.16	K ₂ SO ₄
—	7.73	15.01	"
—	14.01	14.37	"
—	17.08	14.46	" + 1.1.2
—	19.33	13.04	1.1.2
—	26.97	7.67	"
—	32.53	5.86	"
—	33.89	4.48	"
—	35.66	4.01	" + MgSO ₄ ·H ₂ O
—	35.40	2.08	MgSO ₄ ·H ₂ O
—	35.52	0.0	"

1.1.6 = Schonite K₂SO₄·MgSO₄·6H₂O; 1.1.2 = K₂SO₄·MgSO₄·2H₂O (Leonite).

EQUILIBRIUM IN THE SYSTEM POTASSIUM SULFATE, MAGNESIUM
SULFATE AND WATER AT VARIOUS TEMPERATURES. (Continued.)

d of sat. sol.	Gms. per 100 gms. sat. sol.		Solid Phase
	MgSO_4	K_2SO_4	
Results at 75° (Benrath and Sichelschmidt, 1931.)			
1.095	0.0	17.05	K_2SO_4
1.151	8.51	16.13	"
1.225	12.70	15.70	"
1.302	17.18	15.22	" + 1.1.2
1.320	18.12	14.09	1.1.2
1.351	23.32	11.14	"
1.402	26.44	8.70	"
1.419	30.70	7.71	" + 1.2
1.421	31.66	5.44	1.2
1.424	32.13	4.41	"
1.449	35.54	4.02	" + $\text{MgSO}_4 \cdot \text{H}_2\text{O}$
1.437	35.23	2.30	$\text{MgSO}_4 \cdot \text{H}_2\text{O}$
1.435	37.11	1.25	"
1.432	37.30	0.0	"

Results at 85° (Starrs and Storck, 1930.)

—	6.08	18.25	K_2SO_4
—	13.60	17.71	"
—	17.33	16.94	" + 1.1.4
—	19.97	14.86	1.1.4
—	25.49	17.16	" + 1.2
—	24.66	9.56	1.2
—	27.74	6.58	"
—	32.01	3.27	" + $\text{MgSO}_4 \cdot \text{H}_2\text{O}$
—	32.9	0.0	$\text{MgSO}_4 \cdot \text{H}_2\text{O}$

1.1.2 = $\text{K}_2\text{SO}_4 \cdot \text{MgSO}_4 \cdot 2\text{H}_2\text{O}$ (Leonite); 1.2 = $\text{K}_2\text{SO}_4 \cdot 2\text{MgSO}_4$ (Langbeinite);
1.1.4 = $\text{K}_2\text{SO}_4 \cdot \text{MgSO}_4 \cdot 4\text{H}_2\text{O}$.

EQUILIBRIUM IN THE SYSTEM POTASSIUM SULFATE, MAGNESIUM
SULFATE AND WATER AT 100°.
(Benrath and Benrath, 1930.) (Starrs and Storck, 1930.)

d of sat. sol.	Gms. per 100 gms. sat. solution		Solid Phase	Gms. per 100 gms. sat. solution		Solid Phase
	MgSO_4	K_2SO_4		MgSO_4	K_2SO_4	
1.119	0.0	19.42	K_2SO_4	0.0	19.53	K_2SO_4
1.217	7.34	19.46	"	8.69	19.83	"
1.339	16.25	18.75*	"	15.64	19.04	"
—	18.00	18.84*	"	17.33	18.68*	"
1.305	14.47	18.64	" + 1.2	13.75(21.9)	19.00(14.0)	" + 1.2
1.304	18.12	14.26	1.2	16.49	14.98	1.2
1.319	22.63	9.04	"	20.71	10.40	"
1.332	27.44	5.54	"	25.60	6.50	"
1.361	31.00	3.31	" + $\text{MgSO}_4 \cdot \text{H}_2\text{O}$	29.90(34.0)	3.69(3.4)	" + $\text{MgSO}_4 \cdot \text{H}_2\text{O}$
1.367	33.27	0.0	$\text{MgSO}_4 \cdot \text{H}_2\text{O}$	31.75(33.5)	0.0	$\text{MgSO}_4 \cdot \text{H}_2\text{O}$

* Metastable

This system was also studied by Campbell, Downs and Smith, 1934, but their results give a curve which differs considerably from that of Benrath and of Starrs and Storck. Their values for the triple points are shown in parentheses.

Data are given for the reciprocal salt pair $K_2SO_4 + Mg(NO_3)_2 \rightleftharpoons MgSO_4 + K_2(NO_3)_2$ at 0° and 99.5° , Benrath and Benrath, 1930; at 25° and 50° , Benrath and Benrath, 1929a; at 75° , Benrath and Sichelschmidt, 1931.

Data for the system $K_2SO_4 + MgSO_4 + (NH_4)_2SO_4 + H_2O$ at 30° , calculated from the results of Weston, 1922, are given by Jänecke, 1937, 1938.

Data for the system $K_2SO_4 + MgSO_4 + KCl + MgCl_2 + H_2O$ at 100° are given by Campbell, Downes, and Samis, 1934.

SOLUBILITY OF POTASSIUM SULFATE IN AQUEOUS SOLUTIONS
OF MANGANESE SULFATE AND VICE VERSA AT 0° .

(Caven and Johnston, 1927.)

Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase
MnSO ₄	K ₂ SO ₄		MnSO ₄	K ₂ SO ₄	
0.0	6.82	K ₂ SO ₄	27.62	4.48	MnSO ₄ ·K ₂ SO ₄ ·4H ₂ O
6.21	7.75	"	30.28	4.00	"
8.21	7.97	"	34.30	3.35	"
11.80	8.48	"	34.38	2.81	"
13.68	8.88	" + MnSO ₄ ·K ₂ SO ₄ ·4H ₂ O	34.53	1.85	"
17.39	7.60	MnSO ₄ ·K ₂ SO ₄ ·4H ₂ O	34.49	1.68	"
23.64	5.54	"	34.78	0.00	"
25.50	5.00	"			

SO

EQUILIBRIUM IN THE SYSTEM POTASSIUM SULFATE, MANGANESE SULFATE
AND WATER AT VARIOUS TEMPERATURES.

(Benrath, 1930.)

Gms. per 100 gms. sat. solution			Solid Phase	Gms. per 100 gms. sat. solution			Solid Phase
t ^o	MnSO ₄	K ₂ SO ₄		t ^o	MnSO ₄	K ₂ SO ₄	
17.5	14.85	10.85	K ₂ SO ₄ + Mn ₅	66	8.63	16.75	K ₂ SO ₄ + 1.1.2
30	15.46	12.25	" + 1.1.4	"	11.35	14.77	1.2 + "
"	33.64	5.50	1.1.4 + 1.2	80	0.0	17.92	K ₂ SO ₄
35	15.65	13.10	K ₂ SO ₄ ·1.1.2	"	3.48	18.60	"
"	30.40	6.6	1.1.4 + 1.2	"	5.41	18.40	"
40	14.26	13.78	K ₂ SO ₄ + 1.1.2	"	5.84	18.40	" + 1.2
"	27.18	7.22	1.2 + "	"	6.16	17.13	1.2
"	34.66	3.34	" + Mn ₁	"	6.92	13.80	"
50	0.0	14.17	K ₂ SO ₄	"	8.81	10.82	"
"	2.77	15.02	"	"	14.57	6.66	"
"	7.36	15.11	"	"	16.65	6.19	"
"	11.78	15.34	" + 1.1.2	"	20.42	4.85	"
"	14.43	13.40	1.1.2	"	29.58	2.61	" + Mn ₁
"	16.45	12.34	"	"	30.24	0.0	Mn ₁
"	17.17	11.85	"	97	0.0	19.42	K ₂ SO ₄
"	18.30	11.55	"	"	2.09	19.78	"
"	18.70	11.41	" + 1.2	"	3.63	19.89	" + 1.2
"	21.52	9.51	1.2	"	4.05	16.84	1.2
"	24.82	7.30	"	"	4.31	12.80	"
"	27.9	5.85	"	"	5.46	9.68	"
"	35.22	3.49	" + Mn ₁	"	7.08	7.25	"
"	37.3	0.0	Mn ₁	"	11.65	6.00	"
55	10.50	15.91	K ₂ SO ₄ + 1.1.2	"	17.0	4.18	"
"	16.71	12.83	1.2 + "	"	25.92	2.48	" + Mn ₁
"	33.6	3.1	" + Mn ₁	"	28.49	0.0	Mn ₁

1.1.2 = MnSO₄·K₂SO₄·2H₂O; 1.1.4 = MnSO₄·K₂SO₄·4H₂O; 1.2 = K₂SO₄·2MnSO₄
Mn₁ = MnSO₄·H₂O; Mn₅ = MnSO₄·5H₂O.

SOLUBILITY OF MANGANESE SULFATE IN AQUEOUS SOLUTIONS OF
POTASSIUM SULFATE AT 25° AND VICE VERSA. (Caven and Johnston, 1926.)

Gms. per 100 gms. sat. sol.		Solid Phase.	Gms. per 100 gms. sat. sol.		Solid Phase.
MnSO ₄ .	K ₂ SO ₄ .		MnSO ₄ .	K ₂ SO ₄ .	
39.10	0.0	MnSO ₄ ·4H ₂ O	35.58	4.30	1.1.4
39.03	0.43	"	30.47	5.27	"
38.54	1.87	"	19.27	10.06	"
38.42	2.46	"	16.58	12.31	" + K ₂ SO ₄
38.21	3.03	"	15.22	12.04	K ₂ SO ₄
37.92	4.15	" + 1.1.4	6.36	11.27	"
37.28	4.20	1.1.4	0.00	12.59	"

1.1.4 = MnSO₄·K₂SO₄·4H₂O.

SOLUBILITY OF POTASSIUM SULFATE IN AQUEOUS AMMONIA SOLUTIONS AT 20°.
(Girard, 1885.)

Gms. NH ₃ per 100 cc. solution	0	6.086	15.37	24.69	31.02
Gms. K ₂ SO ₄ per 100 cc. solution	10.80	4.10	0.83	0.14	0.04

One liter sat. solution in water contains 105.7 gms. K₂SO₄ at 20°.

One liter sat. solution in 5.2% NH₃ contains 45.2 gms. K₂SO₄ at 20°.

(Konowalow, 1899b.)

EQUILIBRIUM IN THE SYSTEM AMMONIUM SULFATE + POTASSIUM
SULFATE + WATER. (Weston, 1922.)

Results at 25°.

Gms. per 100 gms. sat. sol.		Gms. per 100 gms. Solid Phase.	
K ₂ SO ₄ .	(NH ₄) ₂ SO ₄ .	K ₂ SO ₄ .	(NH ₄) ₂ SO ₄ .
0.0	43.5	0.0	100
1.83	40.9	12.0	86
3.09	38.6	28	72
4.00	37.0	40	60
4.40	35.1	53	47
5.42	31.4	69	31
7.35	22.3	84	16
9.52	10.7	94	6
10.70	0.0	100	0

Results at 30°.

Gms. per 100 gms. sat. sol.		Gms. per 100 gms. Solid Phase.	
K ₂ SO ₄ .	(NH ₄) ₂ SO ₄ .	K ₂ SO ₄ .	(NH ₄) ₂ SO ₄ .
0.0	44.2	0.0	100.0
1.2	42.7	3.3	96.7
2.4	40.9	12.2	87.8
4.1	37.8	28.7	71.3
5.9	33.5	43.6	56.4
6.4	31.0	61.3	38.7
9.1	18.5	74.2	25.8
10.7	8.4	98.2	1.8
11.2	0.0	100.0	0.0

The solid phase at both temperatures consists of a continuous series of mixed crystals. The author also gives complete data for the quaternary system (NH₄)₂SO₄ + MgSO₄ + K₂SO₄ + H₂O. The results are expressed in terms of the H₂O required for the solution of 100 gm. quantities of various mixtures of the three salts.

SOLUBILITY OF MIXED CRYSTALS OF POTASSIUM SULFATE AND AMMONIUM
SULFATE AT 25°.

(Fock, 1897.)

Grams per Liter.		Milligram Mols. per Liter.		Mol. per cent K ₂ SO ₄ in Solution.	Sp. Gr. of Solution.	Mol. per cent K ₂ SO ₄ in Solid Phase.
K ₂ SO ₄ .	(NH ₄) ₂ SO ₄ .	K ₂ SO ₄ .	(NH ₄) ₂ SO ₄ .			
127.9	0.0	734	0.0	100	1.086	100
135.7	115.7	778.5	874.6	47.1	1.149	91.28
84.20	281.1	483	2126	18.5	1.200	80.05
59.28	355.0	340	2685	11.13	1.226	68.63
40.27	482.7	231	3650	5.98	1.246	27.53
0.00	542.3	0.0	4100	0.00	1.245	0.00

Results are also given for 14°, 15°, 16°, 30°, 46°, and 47°.

EQUILIBRIUM IN THE SYSTEM POTASSIUM SULFATE,
AMMONIUM SULFATE AND WATER AT 0° AND AT 50°.
(Jancke, 1927.)

Results at 0°

Gm. Mol. Percent (NH ₄) ₂ SO ₄ in dissolved K ₂ SO ₄ + (NH ₄) ₂ SO ₄	Gm. Mols. H ₂ O to dissolve 100 gms. Mols. Salt mixture
100	100
90	130
80	185
70	250
60	335
50	430 ⁺
0	1160

Results at 50°

Gm. Mol. Percent (NH ₄) ₂ SO ₄ in dissolved K ₂ SO ₄ + (NH ₄) ₂ SO ₄	Gm. Mols. H ₂ O to dissolve 100 gms. Mols. Salt mixture
100	75
90	85
80	100
70	120
60	145
50	780
0	535

The solid phases consist of a series of mixed crystals containing the two salts in a continuous ratio.

The author also gives results for the quarternary systems in the reciprocal salt pair $K_2SO_4 + 2NH_4SO_4 + 2KNO_3 + (NH_4)_2SO_4$ at 0°, 25° & 50°. Similar data for the reciprocal salt pair $[K_2(NH_4)_2] [SO_4, CrO_4]$ at 25° are given by Ishikawa, 1926.)

SOLUBILITY OF POTASSIUM SULFATE IN AQUEOUS SOLUTIONS OF SODIUM
SULFATE.

SO

Results at 25°.
(Smith and Ball, 1917.)

Gms. per 100 Gms. H ₂ O.	Gms. per 100 Gms. H ₂ O.
Na ₂ SO ₄ .	K ₂ SO ₄ .
0	12.05
1.78	12.33
3.58	12.65
5.38	12.89
7.19	13.12

Results at 34° and at 60°
(Nacken, 1910.)

Gms. per 100 Gms. Sat. Sol. at 34°	Gms. per 100 Gms. Sat. Sol. at 34°
Na ₂ SO ₄ .	K ₂ SO ₄ .
0	11.9
7.1	10.7
31.4	4.3
33.1	0

Gms. per 100 Gms. Sat. Sol. at 60°	Gms. per 100 Gms. Sat. Sol. at 60°
Na ₂ SO ₄ .	K ₂ SO ₄ .
0	15.3
6.6	13.9
27.1	8.2
31.3	0

Solid Phase
at 34° and at 60°.

K₂SO₄
" + Glaserite
Na₂SO₄ + Mix crystals
Na₂SO₄

Additional data for the above system at 15°, 25°, 40°, 50°, 60°, 70° and 80° are given by Okada (1914). The results show that potassium and sodium sulfates form a double salt of the composition $K_2Na(SO_4)_2$. This double salt dissolves sodium sulfate as a solid solution but not potassium sulfate.

EQUILIBRIUM IN THE SYSTEM POTASSIUM SULFATE, SODIUM SULFATE AND WATER.
(Hamid, 1926.)

Constant stirring for about 40 hrs. at 25° and 10 hrs. at 90° was employed.

t°.	Gms. per 100 gms. sat. sol. Na ₂ SO ₄ .	Gms. per 100 gms. sat. sol. K ₂ SO ₄ .	Solid Phase
25°.....	19.93	7.06	Na ₂ SO ₄ .10H ₂ O + Mixed crystals of K ₂ Na ₂ (SO ₄) ₂ + Na ₂ SO ₄
25°.....	5.58	11.27	K ₂ SO ₄ + K ₂ Na ₂ (SO ₄) ₂
90°.....	27.05	8.33	Na ₂ SO ₄ + Mixed crystals of K ₂ Na ₂ (SO ₄) ₂ + Na ₂ SO ₄
90°.....	9.23	14.97	K ₂ SO ₄ + K ₂ Na ₂ (SO ₄) ₂

The above results at 25° are taken from Meyerhoffer and Saunders, 1899.

POTASSIUM SULFATE

EQUILIBRIUM IN THE SYSTEM POTASSIUM SULFATE, AMMONIUM
SULFATE AND WATER AT VARIOUS TEMPERATURES.

(Bovalini and Fabris, 1935.)

Gms. per 100 gms. sat. solution		Wt. % K_2SO_4 in Mixed Crystals composing Solid Phase	Gms. per 100 gms. sat. solution		Wt. % K_2SO_4 in Mixed Crystals composing Solid Phase
K_2SO_4	$(NH_4)_2SO_4$		K_2SO_4	$(NH_4)_2SO_4$	
Results at -3.3°			Results at 50°		
6.802	6.201	95.6	13.27	6.09	98.9
Results at -13.63°			10.05	19.67	89.6
			7.5	29.06	81.6
4.448	30.54	83.15	6.09	35.54	70.9
Results at -17.82°			5.49	36.35	64.2
			4.41	39.91	40.0
2.568	36.46	33.9	3.652	40.03	33.0
			0.790	45.23	4.1
			0.580	45.49	1.6
Results at -18.76°			Results at 70°		
1.447	38.29	6.32	16.04	4.58	98.7
Results at 0°			14.61	9.64	97.2
			11.98	20.01	92.2
6.513	7.222	99.1	9.28	27.65	82.8
6.429	12.894	97.8	7.149	34.14	73.9
6.010	18.98	96.1	5.061	39.49	53.0
5.245	25.23	90.1	3.23	43.21	36.8
4.790	30.71	72.8	1.19	45.66	11.1
3.925	31.69	71.6	Results at 96.5°		
2.928	35.21	52.0	17.56	11.82	93.6
2.688	36.99	32.7	9.59	32.30	69.5
2.431	38.82	11.6	7.04	39.23	47.8
0.852	40.90	5.1			
Results at 35°			Result at 103.6° (b.pt.)		
11.80	5.450	99.5	17.10	12.62	86.2
9.651	13.42	89.1	Result at 106.7° (b.pt.)		
9.072	19.41	80.9	8.62	37.23	49.2
7.134	28.50	72.3	Result at 107.2° (b.pt.)		
5.468	34.32	63.6	6.69	42.53	35.0
3.860	38.60	54.1			
2.191	42.22	26.0			
0.698	43.30	5.2			

* Congealing temperature with ice.

SOLUBILITY OF POTASSIUM SULFATE IN AQUEOUS SOLUTIONS
OF SODIUM SULFATE AT 25° AND VICE VERSA.

(Salstrom and Smith, 1930.)

Gms. per 100 gms. H ₂ O		Solid Phase	Gms. per 100 gms. H ₂ O		Solid Phase
Na ₂ SO ₄	K ₂ SO ₄		Na ₂ SO ₄	K ₂ SO ₄	
0.0	12.05	K ₂ SO ₄	27.75	0.0	Na ₂ SO ₄ · 10H ₂ O
2.842	12.485	"	29.574	3.486	"
5.684	12.943	"	31.632	6.759	"
7.92	12.33	5K ₂ SO ₄ · 2Na ₂ SO ₄	32.53	8.288	"
10.63	11.37	"			

EQUILIBRIUM IN THE SYSTEM POTASSIUM SULFATE, SODIUM
SULFATE AND WATER AT VARIOUS TEMPERATURES.

(Cornec and Krombach, 1928, 1929.)

t°	d. of sat. sol.	Gms. per 100 gms. sat. solution		Solid Phase
		Na ₂ SO ₄	K ₂ SO ₄	
0	1.120	5.26	7.75	K ₂ SO ₄ + Na ₂ O
1.8	1.120	5.4	7.8	"
10	1.160	9.75	7.53	Gl + "
"	1.128	5.40	8.99	" + K ₂ SO ₄
20	1.228	17.24	6.94	" + Na ₂ O
"	1.139	5.51	10.33	" + K ₂ SO ₄
28	1.314	26.26	5.49	" + Na ₂ O
"	1.144	5.47	11.37	" + K ₂ SO ₄
30.9	1.363	31.07	4.80	" + Na
34.0	1.357	30.73	5.03	" + "
50	1.339	29.40	5.85	" + "
"	1.157	5.68	13.77	" + K ₂ SO ₄
75	1.322	27.84	7.38	" + Na
"	1.167	5.64	16.43	" + K ₂ SO ₄
100	1.315	26.97	9.15	" + Na
"	1.173	5.52	18.80	" + K ₂ SO ₄

Na = Na₂SO₄; Na₂O = Na₂SO₄ · 10H₂O; Gl = Glaserite; 3K₂SO₄ · Na₂SO₄, a double salt capable of dissolving Na₂SO₄ but not K₂SO₄ to form solid solutions (mixed crystals) with a variation in content of K₂SO₄ from 78.6 to 61.8 percent.

These authors also give data for equilibrium in water, including densities, of potassium and sodium sulfates and nitrates at 50° to 90°.

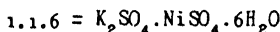
Complete experimental data for equilibrium in aqueous solutions of mixtures of potassium and sodium sulfates, nitrates and chlorides (including densities) at temperatures between 0° and 90° are given by Cornec and Krombach, 1929 and Cornec, Krombach and Spack, 1930. These authors have made use, whenever necessary, of the results for ternary and quaternary systems previously reported from their own laboratory or by others, including Cretien, 1929; Cornec and Hering, 1925-7; Cornec and Krombach, 1929; Meyerhoffer and Saunders, 1899; d'Ans 1915 and Blasdale, 1918.

Data for the system K₂SO₄ + Na₂SO₄ + K₂CO₃ + Na₂CO₃ at 35°, 50° & 75° are given by Teeple, 1929.

EQUILIBRIUM IN THE SYSTEM POTASSIUM SULFATE, NICKEL
SULFATE AND WATER AT DIFFERENT TEMPERATURES.

(Benrath, 1932.)

t°	Gms. per 100 gas. sat. sol.		Solid Phase	t°	Gms. per 100 gas. sat. sol.		Solid Phase
	K ₂ SO ₄	NiSO ₄			K ₂ SO ₄	NiSO ₄	
0	6.80	0.14	K ₂ SO ₄ + 1.1.6	40	2.08	33.35	NiSO ₄ ·6H ₂ O + 1.1.6
"	1.09	21.62	NiSO ₄ ·7H ₂ O + 1.1.6	55	14.76	1.2	K ₂ SO ₄ + 1.1.6
25	1.18	29.52	" " "	"	2.30	35.0	NiSO ₄ ·6H ₂ O + 1.1.6
30	1.30	32.4	" " "	88	2.99	41.19	" "
			NiSO ₄ ·6H ₂ O + 1.1.6	100	20.21	5.19	K ₂ SO ₄ + 1.1.6
40	13.15	0.51	K ₂ SO ₄ + 1.1.6	"	3.60	42.3	NiSO ₄ ·6H ₂ O + 1.1.6



SOLUBILITY OF MIXTURES OF POTASSIUM AND LEAD SULFATES AND OF
POTASSIUM AND STRONTIUM SULFATES IN WATER.

(Barre, 1909.)

Results for K₂SO₄ + PbSO₄.

t°.	Gms. K ₂ SO ₄ per 100 Gms. Sat. Sol.	Solid Phase.
7	0.56	PbSO ₄ ·K ₂ SO ₄
17	0.62	"
50	1.09	"
75	1.37	"
100	1.69	"

Results for K₂SO₄ + SrSO₄.

t°.	Gms. K ₂ SO ₄ per 100 Gms. Sat. Sol.	Solid Phase.
17.5	1.27	K ₂ SO ₄ ·SrSO ₄ + SrSO ₄
50	1.88	"
75	2.71	"
100	3.90	"

EQUILIBRIUM IN THE SYSTEM POTASSIUM SULFATE, PRASEBODIUM
SULFATE AND WATER AT 25°.

(Restaino, 1934.)

Gms. per 100 gas. sat. sol.		Solid Phase	Gms. per 100 gas. sat. sol.		Solid Phase
Pr ₂ (SO ₄) ₃	K ₂ SO ₄		Pr ₂ (SO ₄) ₃	K ₂ SO ₄	
—	4.07	5K ₂ SO ₄ ·Pr ₂ (SO ₄) ₃ ·H ₂ O	0.32	0.88	3K ₂ SO ₄ ·Pr ₂ (SO ₄) ₃ ·2H ₂ O
—	4.01	"	0.40	0.67	3K ₂ SO ₄ ·2Pr ₂ (SO ₄) ₃ ·8H ₂ O
—	3.20	4½K ₂ SO ₄ ·Pr ₂ (SO ₄) ₃	0.52	0.34	—
0.16	1.47	4K ₂ SO ₄ ·Pr ₂ (SO ₄) ₃ ·H ₂ O	1.87	0.27	K ₂ SO ₄ ·Pr ₂ (SO ₄) ₃ ·2H ₂ O
0.18	1.03	3K ₂ SO ₄ ·Pr ₂ (SO ₄) ₃ ·2H ₂ O	2.63	0.19	—

SOLUBILITY OF POTASSIUM SULFATE IN AQUEOUS SOLUTIONS OF ZINC SULFATE
AND VICE VERSA AT 25°. (Caven and Johnston, 1926.)

Gms. per 100 gms. sat. sol.		Solid Phase.	Gms. per 100 gms. sat. sol.		Solid Phase.
K ₂ SO ₄	ZnSO ₄		K ₂ SO ₄	ZnSO ₄	
10.59	0.0	K ₂ SO ₄	2.27	33.01	K ₂ SO ₄ ·ZnSO ₄ ·6H ₂ O
10.71	1.11	"	1.95	35.58	"
10.94	1.91	" + K ₂ SO ₄ ·ZnSO ₄ ·6H ₂ O	1.82	36.00	"
6.52	4.73	K ₂ SO ₄ ·ZnSO ₄ ·6H ₂ O	1.85	36.39	" + ZnSO ₄ ·7H ₂ O
5.99	5.40	"	1.44	36.42	ZnSO ₄ ·7H ₂ O
3.19	25.11	"	0.0	36.61	"

EQUILIBRIUM IN THE SYSTEM POTASSIUM SULFATE, ZINC
SULFATE AND WATER AT VARIOUS TEMPERATURES.
(Benrath, 1930.)

t°	Gms. per 100		Solid Phase	t°	Gms. per 100		Solid Phase
	gms. sat.	sol.			gms. sat.	sol.	
	ZnSO ₄	K ₂ SO ₄			ZnSO ₄	K ₂ SO ₄	
0	0.0	6.88	K ₂ SO ₄ + 1.1.6	80	27.30	10.26	1.1.6
"	3.68	2.91	1.1.6	"	31.00	8.60	"
"	29.83	0.99	1.1.6 + ZnSO ₄ ·7H ₂ O	"	36.84	6.51	"
12	0.37	9.69	K ₂ SO ₄ + 1.1.6	"	38.38	6.60	" + ZnSO ₄ ·H ₂ O
"	32.60	1.82	1.1.6 + ZnSO ₄ ·7H ₂ O	"	38.62	6.02	ZnSO ₄ ·H ₂ O
41	3.18	13.78	K ₂ SO ₄ + 1.1.6	"	38.92	3.59	"
"	40.30	2.50	1.1.6 + ZnSO ₄ ·6H ₂ O	"	40.56	0.0	"
50	4.34	14.28	K ₂ SO ₄ + 1.1.6	180	0.0	19.42	K ₂ SO ₄
"	43.20	2.15	1.1.6 + ZnSO ₄ ·6H ₂ O	"	9.05	20.50	"
68	39.90	4.20	" + ZnSO ₄ ·H ₂ O	"	10.16	21.43	"
80	0.0	17.55	K ₂ SO ₄	"	23.18	20.07	" + 1.1.6
"	2.07	17.87	"	"	24.96	19.13	1.1.6
"	8.48	18.17	"	"	24.40	18.85	"
"	11.80	18.24	"	"	25.82	17.69	"
"	13.46	17.77	"	"	30.62	15.08	"
"	13.67	18.14	" + 1.1.6	"	36.70	13.51	" + ZnSO ₄ ·H ₂ O
"	14.32	16.91	1.1.6	"	36.95	7.15	ZnSO ₄ ·H ₂ O
"	16.29	14.36	"	"	38.85	2.23	"
"	21.04	13.15	"	"	37.71	0.0	"
"	23.00	12.17	"				

1.1.6 = K₂SO₄·ZnSO₄·6H₂O.

SOLUBILITY OF POTASSIUM SULFATE IN AQUEOUS SOLUTIONS OF
URANYL SULFATE AND VICE VERSA AT 25°.
(Colani, 1928.)

Gms. per 100 gms.		Solid Phase	Gms. per 100 gms.		Solid Phase
sat. solution			sat. solution		
UO ₂ SO ₄	K ₂ SO ₄		UO ₂ SO ₄	K ₂ SO ₄	
0.0	10.40	K ₂ SO ₄	31.69	1.91	K ₂ (UO ₂) ₂ (SO ₄) ₂ ·2H ₂ O
0.91	10.67	"	35.97	1.79	"
1.59	11.02	"	39.73	1.77	"
2.39	11.17	"	51.70	0.71	K ₂ (UO ₂) ₂ (SO ₄) ₃ ·5H ₂ O
2.41	9.01	K ₂ (UO ₂) ₂ (SO ₄) ₃ ·2H ₂ O	59.20	0.54	"
2.43	7.31	"	61.50	0.45	"
4.73	3.50	"	61.25	0.23	UO ₂ SO ₄ ·3H ₂ O
9.91	2.69	"	61.18	0.0	"

SOLUBILITY OF POTASSIUM SULFATE IN AQUEOUS ALCOHOL.
(Gerardin, 1865; Schiff, 1861.)

In Aq. Alcohol of 0.939
Sp. Gr. = 40 Wt. %.

t°.	Gms. K ₂ SO ₄ per 100 Gms. Alcohol.
40	0.16
80	0.21
60	0.92

In Alcohol of Different
Strengths at 15°.

Weight per cent Alcohol.	Gms. K ₂ SO ₄ per 100 Gms. Sat. Sol.
10	3.90
20	1.46
30	0.56
40	0.21

SOLUBILITY OF POTASSIUM SULFATE IN AQUEOUS ALCOHOL AT 25°.
(Fox and Gauge, 1910.)

Gms. per 100 Gms. Sat. Solution.			Gms. per 100 Gms. Sat. Solution.		
K ₂ SO ₄ .	C ₂ H ₅ OH.	H ₂ O.	K ₂ SO ₄ .	C ₂ H ₅ OH.	H ₂ O.
9.17	1.35	89.48	2.66	15.26	82.08
6.90	4.80	88.30	1.83	20.50	77.67
4.96	7.80	87.24	0.97	26.91	72.12
4.32	9.70	85.98	0.41	35.97	63.62
3.57	12.34	84.09	0.22	43.90	55.88
2.71	14.51	82.78	0.016	69.26	30.72

SOLUBILITY OF POTASSIUM SULFATE AT 25° (Fox and Gauge, 1910.) IN:
Aqueous Chloral Hydrate Solutions. Aqueous Glycerol Solutions.

Gms. per 100 Gms. Sat. Solution.			Gms. per 100 Gms. Sat. Solution.		
K ₂ SO ₄ .	CCl ₃ CH(OH) ₂ .	H ₂ O.	K ₂ SO ₄ .	(CH ₂ OH) ₂ CHOH.	H ₂ O.
9.13	6.44	84.43	8.87	8.96	82.17
8.41	9.09	82.50	7.69	13.36	78.95
7.79	12.38	79.83	6.47	20.34	73.19
7.31	13.20	79.49	5.83	24.15	70.02
5.88	22.07	72.05	4.44	33.73	61.83
4.54	33.15	62.31	3.65	40.40	55.95
3.36	44.40	52.24	3.38	43.52	53.10
2.92	47.30	49.78	2.69	50.18	47.13
2	62.82	35.18	2.07	57.22	40.71
1.75	70.28	27.97	1.53	67.04	30.53
1.40	80.36	18.24	0.98	78.18	20.84
1.08	85.26	13.66	0.73	98.28	0.99

SOLUBILITY OF POTASSIUM SULFATE AT 25° (Fox and Gauge, 1910.) IN:
Aqueous Acetone Solutions. Aqueous Pyridine Solutions.

Gms. per 100 Gms. Sat. Solution.			Gms. per 100 Gms. Sat. Solution.		
K ₂ SO ₄ .	(CH ₃) ₂ CO.	H ₂ O.	K ₂ SO ₄ .	CH<(CH ₃ CH) ₂ >N.	H ₂ O.
7.20	4.92	87.88	7.95	4.23	87.82
5.02	10.06	84.92	4.77	13.90	81.33
2.96	16.23	80.81	2.75	24.51	72.74
1.50	24.31	74.19	1.47	34.10	64.34
0.47	37.19	62.31	0.45	46.29	53.26
0.20	46.29	53.51	0.12	55.93	43.95
0.03	62.40	37.57	0.006	75.90	24.09

SOLUBILITY OF POTASSIUM SULFATE AT 25° (Fox and Gauge, 1910.) IN:
Aqueous Ethylene Glycol Solutions. Aqueous Mannitol Solutions.

Gms. per 100 Gms. Sat. Solution.			Gms. per 100 Gms. Sat. Solution.		
K ₂ SO ₄ .	(CH ₂ OH) ₂ .	H ₂ O.	K ₂ SO ₄ .	(CHOH) ₄ (CH ₂ OH) ₂ .	H ₂ O.
9.67	3.16	87.17	10.32	3.20	86.48
7.69	9.79	82.53	9.61	8.35	82.04
5.74	18.47	75.79	9.19	11.26	79.55
3.57	32.11	64.32	8.66	14.30	77.04
1.83	49.03	49.14	8.35	17.22	74.43

SOLUBILITY OF POTASSIUM SULFATE AT 25° IN:

Aq. Sucrose Solutions.
(Fox and Gauge, 1910.)

Aq. Potassium Acetate Solutions.
(Fox, 1909.)

Gms. per 100 Gms. Sat. Solution.			Gms. per 100 Gms. Sat. Solution.		
K ₂ SO ₄ .	C ₁₂ H ₂₂ O ₁₁ .	H ₂ O.	K ₂ SO ₄ .	CH ₃ COOK.	H ₂ O.
9.65	9.56	80.79	6.65	6.11	87.24
8.65	18.55	72.80	5.09	8.68	86.23
7.42	28.16	64.42	3.99	11.29	84.72
6.35	37.24	56.41	2.35	15.59	82.06
5.21	47.55	47.24	1.23	20.12	78.65
4.24	57	38.76	0.39	29.95	69.66

100 gms. glycerol of $d = 1.255$ dissolve 1.316 gms. K₂SO₄ at ord. temp. (Vogel, 1867.)

SOLUBILITY OF POTASSIUM SULFATE IN AQUEOUS ACETIC ACID AND IN
AQUEOUS PHENOL SOLUTIONS AT 25°.

(Rothmund and Wilsmore, 1902.)

In Aq. Acetic Acid.

In Aq. Phenol.

Mols. per Liter.		Grams per Liter.		Mols. per Liter.		Grams per Liter.	
CH ₃ COOH.	K ₂ SO ₄ .	CH ₃ COOH.	K ₂ SO ₄ .	C ₆ H ₅ OH.	K ₂ SO ₄ .	C ₆ H ₅ OH.	K ₂ SO ₄ .
0.0	0.6714	0.0	117.0	0.0	0.6714	0.0	117.0
0.07	0.6619	4.2	115.4	0.032	0.6598	3.01	115.0
0.137	0.6559	8.22	114.4	0.064	0.6502	6.02	113.3
0.328	0.6350	19.68	110.8	0.127	0.6310	11.94	110.0
0.578	0.6097	34.68	106.3	0.236	0.6042	22.19	105.3
1.151	0.5556	69.06	96.87	0.308	0.5834	28.97	101.7
2.183	0.4743	128.58	82.70	0.409	0.5572	38.46	97.2
				0.464	0.5480	43.63	95.5
				0.498 (sat.)	0.5377	46.82	93.8

100 gms. water dissolve 10.4 gms. K₂SO₄ + 219 gms. sugar at 31.25°, or 100 gms. sat. solution contain 3.18 gms. K₂SO₄ + 66.74 gms. sugar. (Köhler, 1897.)

100 gms. 95% formic acid dissolve 36.5 gms. K₂SO₄ at 21°. (Aschan, 1913.)

100 gms. 95% formic acid dissolve 14.6 gms. KHSO₄ at 19.3°. "

100 cc. anhydrous hydrazine dissolve 5 gms. K₂SO₄ at room temp.

100 gms. hydroxylamine dissolve 3.5 gms. K₂SO₄ at 17-18°. (Welsh and Broderson, 1915.)
(de Bruyn, 1892.)

SOLUBILITY OF POTASSIUM SULFATE IN AQUEOUS SOLUTIONS
OF METHYL ALCOHOL AT 25°.
(Akerlof and Turck, 1935.)

Wt. Percent CH ₃ OH in Aq. Solvent	Gm. Mols. K ₂ SO ₄ per 1000 gms. Aq. Solvent	Wt. Percent CH ₃ OH in Aq. Solvent	Gm. Mols. K ₂ SO ₄ per 1000 gms. Aq. Solvent
0.0	0.6905	29.99	0.0536
9.7	0.3049	40.10	0.0221
15.09	0.1933	59.94	0.00342
21.30	0.1134		

SOLUBILITY OF POTASSIUM SULFATE IN AQUEOUS ETHYL ALCOHOL.
(Wright, 1927.)

t°	Wt. Percent C ₂ H ₅ OH in Aq. Solvent	Gms. K ₂ SO ₄ per 100 gms. Aq. Solvent
20	50.0	0.14
100	50.0	0.51

SOLUBILITY OF POTASSIUM SULFATE IN AQUEOUS SOLUTIONS
OF VARIOUS COMPOUNDS AT 25°.
(Weber, 1929.)

Aqueous Solution of:	Gm. Mols. K ₂ SO ₄ per liter in Aq. Solution of:			
	0.125 Normality	0.25 Normality	0.5 Normality	1.0 Normality
Water alone	0.5562	0.5562	0.5562	0.5562
Cane Sugar	0.5537	0.5555	0.5532	0.5430
Mannite	0.5518	0.5538	0.5496	0.5421
Methyl Alcohol	0.5415	0.5295	0.5000	0.4518
Acetonitrile	0.5398	0.5259	0.4381	0.4332
Ethyl Alcohol	0.5356	0.5187	0.4783	0.4023
Acetone	0.5313	0.5086	0.4574	0.3827
Methyl Acetate	0.5408	0.5249	0.4938	0.4336
Propyl Alcohol	0.5311	0.5068	0.4577	0.3861
Methyl Ethyl Ketone	0.5308	0.5030	0.4545	0.3744
Diethyl Amine	0.5293	0.5040	0.4623	0.3662
Phenol	0.5291	0.5030	0.4556	—
Aniline	0.5224	0.5079 (1)	—	—
Paraldehyde	0.5229	0.4931	0.4287	—
Ethyl Acetate	0.5365	0.5186	0.4828	—
Butyric Acid	0.5410	0.5292	0.5055	0.4618
Ter. Amyl Alcohol	0.5178	0.4797	0.4141	0.3153
Valerianic Acid	0.5392	0.5236	—	—
Iso Amyl Alcohol	0.5158	0.5065 (2)	—	—
Hexyl Alcohol	0.5476 (3)	0.5407 (4)	—	—

(1) = 0.2 Normality instead of 0.25; (2) = 0.185 Normality instead of 0.25; (3) = 0.0208 Normality instead of 0.125; (4) = 0.0416 Normality instead of 0.25.

SOLUBILITY OF POTASSIUM SULFATE IN AQUEOUS SOLUTIONS
OF ETHYLENE GLYCOL AT 30°.
(Trimble, 1931.)

g. of sat. sol.	Gms. per 100 gms. sat. sol.		g. of sat. sol.	Gms. per 100 gms. sat. sol.	
	$\text{CH}_2\text{OHCH}_2\text{OH}$	K_2SO_4		$\text{CH}_2\text{OHCH}_2\text{OH}$	K_2SO_4
1.0881	0.0	11.14	1.0646	38.58	2.41
1.0812	4.21	9.84	1.0708	49.75	1.45
1.0737	9.01	8.11	1.0823	65.62	0.63
1.0651	18.64	5.66	1.1060	100.00	0.00
1.0627	28.91	3.67			

SOLUBILITY OF POTASSIUM SULFATE IN AQUEOUS SOLUTIONS OF URETHAN AT 25°.
(Palitzsch, 1926, 1929.)

Gm. Mols. per 1000 gms. H_2O		Solid Phase
K_2SO_4	$\text{NH}_2\text{COOC}_2\text{H}_5$	
0.690	0.0	K_2SO_4
0.468	1.1225	"
0.026	23.49	"
0.016	50.45	"

SO

SOLUBILITY OF SOME POTASSIUM DOUBLE SULFATES IN WATER AT 25°.
(Locke, 1902.)

Double Salt.		Formula.	Gms. Anhydrous Salt per 100 Gms. H_2O .
Potassium Cobalt Sulfate		$\text{K}_2\text{Co}(\text{SO}_4)_2 \cdot 6\text{H}_2\text{O}$	12.88
" Copper "		$\text{K}_2\text{Cu}(\text{SO}_4)_2 \cdot 6\text{H}_2\text{O}$	11.60
" Nickel "		$\text{K}_2\text{Ni}(\text{SO}_4)_2 \cdot 6\text{H}_2\text{O}$	6.88
" Zinc "		$\text{K}_2\text{Zn}(\text{SO}_4)_2 \cdot 6\text{H}_2\text{O}$	13.19

SOLUBILITY OF POTASSIUM NICKEL SULFATE AND ALSO OF POTASSIUM ZINC
SULFATE IN WATER, EACH SEPARATELY DETERMINED AT DIFFERENT TEM-
PERATURES.

t°.	Gms. per 100 Gms. H_2O .		t°.	Gms. per 100 Gms. H_2O .	
	$\text{K}_2\text{Ni}(\text{SO}_4)_2 \cdot 6\text{H}_2\text{O}$	$\text{K}_2\text{Zn}(\text{SO}_4)_2 \cdot 6\text{H}_2\text{O}$		$\text{K}_2\text{Ni}(\text{SO}_4)_2 \cdot 6\text{H}_2\text{O}$	$\text{K}_2\text{Zn}(\text{SO}_4)_2 \cdot 6\text{H}_2\text{O}$
0	6	13	40	23	45
10	9	19	50	28	56
20	14	26	60	35	72
25	16	30	70	43	88
30	18	35			

SOLUBILITY OF POTASSIUM NICKEL SULFATE IN WATER.
(Lattay, 1925.)

t°	Gms. $\text{K}_2\text{Ni}(\text{SO}_4)_2$ per 100 gms. sat. sol.	Solid Phase	t°	Gms. $\text{K}_2\text{Ni}(\text{SO}_4)_2$ per 100 gms. sat. sol.	Solid Phase
0	3.26	$\text{K}_2\text{Ni}(\text{SO}_4)_2 \cdot 6\text{H}_2\text{O}$	40	8.97	$\text{K}_2\text{Ni}(\text{SO}_4)_2 \cdot 6\text{H}_2\text{O}$
10	4.31	"	50	11.02	"
15	4.93	"	60	13.33	"
20	5.61	"	70	15.88	"
25	6.36	"	80	18.68	"
30	7.17	"	90	21.74	"
			100	25.04	"

100 gms. H_2O sat. with Potassium Neodymium Sulfate, $KNd(SO_4)_2 \cdot H_2O$, contain 1.7 gm. $KNd(SO_4)_2$ at 0° and 1.3 gms. at 20° . (Meyer and Kittlemann, 1931.)

One liter sat. solution of Potassium Zinc Sulfate in Water contains 85.94 gms. $K_2Zn(SO_4)_2$ at 6.8° . (Haber-Chuwis, 1926.)

Fusion-point data are given for the following mixtures:

$K_2SO_4 + H_2SO_4$	(Kendall and Landon, 1920; Cambi and Bozza, 1923.)
$KHSO_4 + K_2S_2O_7$	(Cambi and Bozza, 1923.)
$K_2SO_4 + K_2WO_4$	(Amadori, 1913.)
" + NH_4NO_3	(Bowen, 1926.)
" + $NaCl$	(Sackur, 1911-12.)
" + Na_2SO_4	(Jänecke, 1908; Nacken, 1907 (b)(c); Sackur, 1911-12.)
" + $RbCl$	(Dombrowskaya, 1933.)
" + Rb_2SO_4	" "
" + $SrSO_4$	(Grahmann, 1913; Calcagni, 1912, 1912a.)

POTASSIUM Ethyl SULFATE $K(C_2H_5)SO_4$.

SOLUBILITY IN WATER.

(Illingworth and Howard, 1884.)

t° .	Gms. $K(C_2H_5)SO_4$ per 100 Gms. Sat. Sol.
-14.2	45.01
0	53.71
+15	62.35

SOLUBILITY OF POTASSIUM ETHYL SULFATE, POTASSIUM METHYL SULFATE AND OF POTASSIUM AMYL SULFATE IN WATER, DETERMINED BY THE FREEZING-POINT METHOD.

(Illingworth and Howard, 1884.)

Results for $K(C_2H_5)SO_4 + H_2O$.			Results for $K(CH_3)SO_4 + H_2O$.			Results for $K(C_4H_9)SO_4 + H_2O$.		
t° of Solidification.	Gms. $K(C_2H_5)SO_4$ per 100 Gms. Sol.	Solid Phase.	t° of Solidification.	Gms. $K(CH_3)SO_4$ per 100 Gms. Sol.	Solid Phase.	t° of Solidification.	Gms. $K(C_4H_9)SO_4$ per 100 Gms. Sol.	Solid Phase.
-2.2	10	Ice	-2.3	10	Ice	-1.0	10	Ice
-4.9	20	"	-3.6	15	"	-4.3	20	"
-8.2	30	"	-5	20	"	-5.4	24	"
-12.1	40	"	-8	30	"			$+K(C_4H_9)SO_4$
-14.2	45.01	" + $K(C_2H_5)SO_4$	-11.8	39.84	" + $K(CH_3)SO_4$	-4.8	25	$K(C_4H_9)SO_4$
-6	50	$K(C_2H_5)SO_4$	-11.5	40	$K(CH_3)SO_4$	0	33.44	"
0	53.71	"	0	47.1	"	+17.3	59.46	"
+15	62.35	"	+12.3	54.8	"			

100 gms. methyl alcohol dissolve 1.72 gms. Potassium ethyl sulfate at 15° and 13.87 gms. at the b. pt. (65.8°). (Henstock, 1934.)

SOLUBILITY OF POTASSIUM ETHYL SULFATE IN MIXTURES OF METHYL ALCOHOL AND ACETONE AT 20° .

(Henstock, 1934.)

The results are given only in the form of a diagram from which the following approximate values were read.

Percent Acetone in Mixed Solvent	Gms. $K(C_2H_5)SO_4$ per 100 gms. Solvent	Percent Acetone in Mixed Solvent	Gms. $K(C_2H_5)SO_4$ per 100 gms. Solvent
0 ($=CH_3OH$)	2.2	60	2.25
10	2.55	70	1.75
20	2.8	80	1.25
30	2.95	90	0.70
40	2.8	100 ($=CH_3COCH_3$)	0.0

POTASSIUM Ethyl SULFATE $\text{KC}_2\text{H}_5\text{SO}_4$, α and β forms.

SOLUBILITY OF POTASSIUM ETHYL SULFATE IN WATER. (Hamrick and Mullaby, 1921.)

This compound is dimorphous. On crystallizing from methyl alcohol or water there first appear tufts of long feathery crystals which redissolve as the solution cools and give place to the ordinary foliated form. Analysis showed no difference in composition between the two forms. The temperatures were determined at which the edges of crystals, present in synthetic mixtures contained in sealed tubes, changed from rounded to sharp or vice versa. No matter at what temperature crystallization occurred the unstable β form was always the first to separate. It was easy to distinguish which solid phase was present at the different temperatures. The transition point was found to be at $51^\circ.8$. The ice curve was determined by the freezing-point method.

t° .	Gms. $\text{KC}_2\text{H}_5\text{SO}_4$ per 100 gms. sat. sol.	Solid Phase.	t° of solution for		Gms. $\text{KC}_2\text{H}_5\text{SO}_4$ per 100 gms. sat. sol.
			α form.	β form.	
— 1.195.....	5.480	Ice	— 4.5	— 13.5	49.5
— 1.142.....	6.37	"	— 1.9	—	51.946
— 2.130.....	9.434	"	+ 8.7	— 5.2	58.81
— 2.98.....	12.953	"	21.0	+ 12.1	66.6
— 3.22.....	13.770	"	26.0	20.1	70.015
— 4.93.....	19.808	"	35.0	32.0	75.29
— 6.68.....	25.953	"	39.9	38.2	77.99
— 9.55.....	33.714	"	45.5	45.0	80.084
— 12.9 (eutec.) . . .	—	" + α form	51.14	51.1	82.04
— 15.2 "	—	" + β "	59.46		84.44
			65.8		85.47
			69.1		86.23
			81.3		87.94
			91.2		89.62

POTASSIUM N-Phenyl β Amino Ethyl Hydrogen SULFATE $\text{C}_6\text{H}_5\text{NH.C}_2\text{H}_4\text{O.SO}_3\text{K}$.

100 cc. sat. sol. of the above compound in water contain 23.0 gms. $\text{C}_6\text{H}_5\text{NH.C}_2\text{H}_4\text{O.SO}_3\text{K}$ at 15° . (Saunders, 1922.)

POTASSIUM Phenyl SULFATE, $\text{C}_6\text{H}_5\text{O}_4\text{SK}$, etc.

SOLUBILITY OF EACH SEPARATELY IN WATER AND ALCOHOL.
(Burkhardt and Lapworth, 1926.)

Compound.	Formula.	Solvent.	t° .	Gms. compd. per 100 gms. H_2O .
Potassium phenyl sulfate.....	$\text{C}_6\text{H}_5\text{O}_4\text{SK}$	Water	17	16.28
" " " " " " " " " " " "	"	Alcohol	17	0.704
" <i>m</i> carboxy phenyl sulfate.	$\text{C}_7\text{H}_5\text{O}_6\text{SK}$	Water	17	3.2
" α naphthyl " " " " " "	$\text{C}_{10}\text{H}_7\text{O}_4\text{SK}$	"	17	2.5
" β " " " " " " " "	$\text{C}_{10}\text{H}_7\text{O}_4\text{SK.4H}_2\text{O}$	"	17	1.13

POTASSIUM PerSULFATE $\text{K}_2\text{S}_2\text{O}_8$.

SOLUBILITY IN WATER.

(Tarugi, 1904.)

t° .	Gms. $\text{K}_2\text{S}_2\text{O}_8$ per 100 cc. Sat. Sol.	t° .	Gms. $\text{K}_2\text{S}_2\text{O}_8$ per 100 cc. Sat. Sol.	t° .	Gms. $\text{K}_2\text{S}_2\text{O}_8$ per 100 cc. Sat. Sol.
0	1.620	15	3.140(3.7)	30	7.190(7.7)
5	2.156	20	4.490	35	8.540
10	2.600	25	5.840	40	9.890

The results in parentheses are the averages of a large number of determinations by Pajetta (1906). This investigator employed constant agitation for various lengths of time. Tarugi approached equilibrium from above as well as below but stirred the solutions only at intervals. The determination of the dissolved persulfate was made by boiling a measured volume of the clear saturated solution for 20 min. and titrating the H_2SO_4 liberated, according to the equation $\text{K}_2\text{S}_2\text{O}_8 + \text{H}_2\text{O} = \text{K}_2\text{SO}_4 + \text{H}_2\text{SO}_4 + \text{O}$. Tarugi also reports that the presence of a number of sodium and other salts in solution, does not appreciably alter the solubility of $\text{K}_2\text{S}_2\text{O}_8$ in water.

100 gms. H_2O dissolve 1.77 gms. $\text{K}_2\text{S}_2\text{O}_8$ at 0° .

(Marshall, 1891.)

SOLUBILITY OF POTASSIUM PERSULFATE IN SATURATED AQUEOUS SALT
SOLUTIONS AT 12°.
(Pajetta, 1906.)

(An excess of the salt and of $K_2S_2O_8$ was, in each case, added to water and the mixture stirred at constant temperature for 10 to 20 hours.)

Salt.	Gms. $K_2S_2O_8$ per 100 Gms. Sat. Sol.	Salt.	Gms. $K_2S_2O_8$ per 100 Gms. Sat. Sol.
Water alone	3.196	K_2SO_4	0.798
$Na_2SO_4 \cdot 10H_2O$	6.238	$KHSO_4$	0.336
$NaHSO_4$	8.842	KNO_3	0.904
$Na_2HPO_4 \cdot 12H_2O$	4.766	K_2CO_3	0.0146
$Na_2B_4O_7 \cdot 10H_2O$	3.825	$KHCO_3$	0.317
$NaNO_3$	19.302	$MgSO_4 \cdot 7H_2O$	2.990
$Na_2CO_3 \cdot 10H_2O$	5.682	$CaSO_4 \cdot 2H_2O$	3.384
$NaHCO_3$	5.042		

Additional determinations made with salt solutions of lower concentrations than saturation, gave the following results at 12.5°.

Salt.	Gms. Salt per 100 Gms. H_2O .	Gms. $K_2S_2O_8$ per 100 Gms. Sat. Sol.	Salt.	Gms. Salt per 100 Gms. H_2O .	Gms. $K_2S_2O_8$ per 100 Gms. Sat. Sol.
Na_2CO_3	2.304	4.297	$NaHSO_4$	5.218	4.556
$NaHCO_3$	3.652	4.230	$NaNO_3$	3.696	4.613
$Na_2SO_4 \cdot 10H_2O$	7	4.554	Na_2HPO_4	3.086	4.446

POTASSIUM THIOSULFATE $K_2S_2O_3$.

SOLUBILITY IN WATER. (Jo, 1911, 1912.)

t°.	Gms. $K_2S_2O_3$ per 100 Gms. H_2O .	Solid Phase.	t°.	Gms. $K_2S_2O_3$ per 100 Gms. H_2O .	Solid Phase.
0	96.1	$K_2S_2O_3 \cdot 2H_2O$	56.1	234.5	$K_2S_2O_3 \cdot H_2O$ + $3K_2S_2O_3 \cdot H_2O$
17	150.5	$3K_2S_2O_3 \cdot 5H_2O$	60	238.3	$3K_2S_2O_3 \cdot H_2O$
20	155.4	"	65	245.8	"
25	165	"	70	255.2	"
30	175.7	"	75	268	"
35	202.4	" + $K_2S_2O_3 \cdot H_2O$	78.3	292	" + $K_2S_2O_3$
40	204.7	$K_2S_2O_3 \cdot H_2O$	80	293.1	$K_2S_2O_3$
45	208.6	"	85	298.5	"
50	215.2	"	90	312	"
55	227.7	"			

POTASSIUM Sodium THIOSULFATE $KNaS_2O_3 \cdot 2H_2O$.

100 gms. H_2O dissolve 213.7 gms. $KNaS_2O_3 \cdot 2H_2O$ (a) at 15°. (Schwicker 1889.)
100 gms. H_2O dissolve 205.3 gms. $KNaS_2O_3 \cdot 2H_2O$ (b) at 15°. "

POTASSIUM THIONATES

SOLUBILITY OF EACH SEPARATELY IN WATER.

(Results for Dithionate by deBeat, 1926; for the others by Kurtenacker and Fluss, 1928.)

t°	Gms. per 100 gms. sat. solution			
	K Dithionate $K_2S_2O_6$	K Trithionate $K_2S_3O_6$	K Tetrathionate $K_2S_4O_6$	K Pentathionate $K_2S_5O_6$ (1-1/2 H_2O)
0	2.52	8.14	12.60	15.50
12	4.28	—	—	—
20	6.23	18.43	23.18	24.78
30	8.54	—	—	—

POTASSIUM THIONATES

EQUILIBRIUM IN THE SYSTEM POTASSIUM TRITHIONATE,
POTASSIUM TETRATHIONATE AND WATER.

(Kurtenacker and Fluss, 1933.)

t°	Gms. per 100 gms. sat. sol.		Solid Phase	t°	Gms. per 100 gms. sat. sol.		Solid Phase
	$K_2S_3O_6$	$K_2S_4O_6$			$K_2S_3O_6$	$K_2S_4O_6$	
0	6.68	12.00	$K_2S_4O_6 + K_2S_3O_6$	20	14.51	14.17	$K_2S_3O_6$
20	1.80	21.85	$K_2S_4O_6$	"	16.70	11.94	"
"	2.30	21.60	"	"	16.23	5.75	"
"	6.86	18.82	"	"	17.67	2.37	"
"	11.50	18.90	"	"	6.68	12.00	"
"	13.26	18.65	" + $K_2S_3O_6$				

EQUILIBRIUM IN THE SYSTEM POTASSIUM TETRATHIONATE, POTASSIUM
PENTATHIONATE AND WATER.

(Kurtenacker and Fluss, 1933.)

t°	Gms. per 100 gms. sat. sol.		Solid Phase	t°	Gms. per 100 gms. sat. sol.		Solid Phase
	$K_2S_4O_6$	$K_2S_5O_6$			$K_2S_4O_6$	$K_2S_5O_6$	
0	4.71	14.49	$K_2S_4O_6 + K_2S_5O_6 \cdot 1\frac{1}{2}H_2O$	20	10.53	19.81	$K_2S_4O_6$
20	2.53	21.39	$K_2S_5O_6 \cdot 1\frac{1}{2}H_2O$	"	11.71	17.62	"
"	5.86	20.59	"	"	14.04	14.30	"
"	7.53	20.19	"	"	17.39	8.70	"
"	10.34	20.86	"	"	18.93	6.44	"
"	10.88	20.10	" + $K_2S_4O_6$	"	22.46	0.82	"

EQUILIBRIUM IN THE SYSTEM POTASSIUM TRITHIONATE, POTASSIUM
PENTATHIONATE AND WATER.

(Kurtenacker and Fluss, 1933.)

t°	Gms. per 100 gms. sat. sol.		Solid Phase	t°	Gms. per 100 gms. sat. sol.		Solid Phase
	$K_2S_3O_6$	$K_2S_5O_6$			$K_2S_3O_6$	$K_2S_5O_6$	
0	7.6	2.87	$K_2S_3O_6 + K_2S_5O_6 \cdot 1\frac{1}{2}H_2O + S$	20	10.84	9.98	$K_2S_3O_6 + S$
20	6.35	7.20	$K_2S_5O_6 \cdot 1\frac{1}{2}H_2O + S$	"	14.04	3.74	"
"	8.13	8.17	"	"	14.12	4.37	"
"	10.50	8.72	" + $K_2S_3O_6 + S$	"	14.99	2.46	"

High accuracy is not claimed for the above results since the polythionates begin to decompose after short periods of shaking.

POTASSIUM SELENITE $K_2SeO_3 \cdot 5H_2O$.SOLUBILITY OF POTASSIUM SELENITE IN WATER.
(Janickis, 1937; Janickis and Outmanate, 1936.)

t°	d. of sat. sol.	Gms. K_2SeO_3 per 100 gms. sat. sol.	Solid Phase
- 0.262	1.007	1.02	Ice
- 0.50	1.015	2.02	"
- 0.97	1.029	3.99	"
- 2.375	1.075	9.54	"
- 5.03	1.148	17.87	"
-13.0	1.282	32.01	"
-23.6	1.452	45.13	"
-43.5 (Eutec.)	—	58.00	" + $K_2SeO_3 \cdot 4H_2O$
-20.5	—	59.98	$K_2SeO_3 \cdot 4H_2O$
- 9.7	—	61.14	"
- 0.2	—	62.76	"
+10.5	—	65.11	"
13.5	—	65.83	"
19.5	—	67.00	"
24.3 (tr.pt.)	—	68.5	" + K_2SeO_3
0	—	68.45*	K_2SeO_3
20.3	—	68.48*	"
43.1	—	68.52	"
60.1	—	68.70	"
100.6	—	68.53	"

* Metastable

POTASSIUM BISELENITE $KHSeO_3$
POTASSIUM Pyro SELENITE $K_2Se_2O_5$ SOLUBILITY OF POTASSIUM BISELENITE AND PYROSELENITE, IN WATER.
(Janickis, 1939; Janickis and Outmanate, 1936.)

t°	d. of sat. sol.	Gms. $K_2Se_2O_5$ per 100 gms. sat. sol.	Solid Phase	t°	Gms. $K_2Se_2O_5$ per 100 gms. sat. sol.	Solid Phase
- 0.166	1.003	0.63	Ice	12.8	77.21	$KHSeO_3$
- 0.365	1.010	1.565	"	18.9	78.18	"
- 0.694	1.023	3.09	"	23.0	78.70	"
- 1.342	1.047	6.04	"	25.2	79.31*	"
- 3.17	1.119	14.12	"	30.6	80.04*	"
- 6.285	1.237	25.55	"	24.	79.0(?)	" + $K_2Se_2O_5$
-14.3	1.466	43.13	"	27.2	79.21	$K_2Se_2O_5$
-22.7	1.6055	52.55	"	31.7	79.41	"
-57.0(?)	—	70.0(?)	" + $KHSeO_3$	50.4	80.39	"
-20.6	—	73.52	$KHSeO_3$	69.6	82.45	"
-10.5	—	74.29	"	90.8	83.72	"
+ 0.2	—	75.87	"	102.8	84.47	"

* Metastable

K KALIUM

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POTASSIUM Tetra SELENITE $\text{KH}_3(\text{SeO}_3)_2$.

SOLUBILITY OF POTASSIUM TETRA SELENITE IN WATER.

(Janickis, 1932; Janickis and Outenaitis, 1934.)

t°	d. of sat. sol.	Gms. $\text{KH}_3(\text{SeO}_3)_2$ per 100 gms. sat. sol.	Solid Phase	t°	Gms. $\text{KH}_3(\text{SeO}_3)_2$ per 100 gms. sat. sol.	Solid Phase
-0.178	1.003	0.59	Ice	-6.9	46.52	$\text{KH}_3(\text{SeO}_3)_2$
-0.288	1.009	1.467	"	0.0	53.57	"
-0.544	1.019	2.905	"	+11.9	63.20	"
-1.027	1.040	5.69	"	20.3	68.65	"
-2.302	1.102	13.43	"	31.0	75.71	"
-4.10	1.202	24.62	"	40.2	80.30	"
-7.42	1.399	42.3	"	50.8	85.55	"
-8.0	—	46.0	" + $\text{KH}_3(\text{SeO}_3)_2$	59.4	89.65	"

POTASSIUM SELENATE K_2SeO_4 .

SOLUBILITY IN WATER.

	t°.	-20°.	-5°.	+5°.	18°.	97°.
SeO	Gms. K ₂ SeO ₄ per 100 gms. solution	51.5	51.7	52	52.6	54.9

100 gms. H_2O dissolve 115 gms. K_2SeO_4 at 12°.

(Etard, 1891.)

(Tutton, 1907.)

More recent determinations by Meyer and Aulich, 1928 and Friend, 1929, fail to agree and a satisfactory explanation of the difference is not apparent. Although Friend employed a period of shaking of only 2 hours and Meyer and Aulich, 4 to 6 hours his results are the higher. The following values were taken from average curves drawn from the original results in the two cases.

t°	Gms. K_2SeO_4 per 100 gms. sat. sol. (Meyer & Aulich)	(Friend)	t°	Gms. K_2SeO_4 per 100 gms. sat. sol. (Meyer & Aulich)	(Friend)
-20	51.5	—	40	53.55	54.15
0	51.8	53.55	50	53.95	54.4
10	52.2	53.55	60	54.3	54.7
20	52.6	53.7	70	54.55	55.0
25	52.85	53.8	85	54.85	55.6
30	53.1	53.95	100	55.0	56.2

EQUILIBRIUM IN THE SYSTEM POTASSIUM SELENATE, MAGNESIUM SELENATE AND WATER AT 25°.

(Meyer and Aulich, 1928.)

Gms. per 100 gms. sat. sol. K_2SeO_4	MgSeO_4	Solid Phase	Gms. per 100 gms. sat. sol. K_2SeO_4	MgSeO_4	Solid Phase
53.3	0.0	K_2SeO_4	21.83	11.40	1.1.6
51.13	0.56	"	21.40	11.48	" + $\text{MgSeO}_4 \cdot 6\text{H}_2\text{O}$
50.58	0.63	"	19.95	12.90	$\text{MgSeO}_4 \cdot 6\text{H}_2\text{O}$
47.31	0.89	" + 1.1.6	19.59	13.37	"
38.50	2.12	1.1.6	5.82	24.36	"
30.24	5.44	"	0.0	27.5	"

1.1.6 = $\text{K}_2\text{SeO}_4 \cdot \text{MgSeO}_4 \cdot 6\text{H}_2\text{O}$.

EQUILIBRIUM IN THE SYSTEM POTASSIUM SELENATE, SODIUM
SELENATE AND WATER AT 25°.
(Meyer and Aulich, 1928.)

Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase
K_2SeO_4	Na_2SeO_4		K_2SeO_4	Na_2SeO_4	
53.3	0.0	K_2SeO_4	23.24	28.52	K_2SeO_4
45.20	7.21	"	21.86	31.29	$K_2SeO_4 + Na_2SeO_4$
37.72	12.76	"	19.87	31.78	Na_2SeO_4
30.02	19.90	"	17.42	32.34	"
26.80	25.36	"	0.0	36.40	"

POTASSIUM Neodymium SELENATE $KNd(SeO_4)_2 \cdot 4H_2O$.

100 gms. H_2O sat. with $KNd(SeO_4)_2 \cdot 4H_2O$ contain 15.0 gms. $KNd(SeO_4)_2$ at 0° and 25.0 gms. at 20°. (Meyer and Kittlemann, 1931.)

POTASSIUM SILICATE K_2SiO_3 .

Data for equilibrium in the systems $K_2SiO_3 + H_2O$, $K_2Si_2O_5 + H_2O$, $K_2SiO_3 + SiO_2$, $SiO_2 + H_2O$ and $K_2SiO_3 + SiO_2 + H_2O$, at temperatures between 200° and 1000° +, determined by the "hydrothermal quenching method," are given by Morey (1917).

POTASSIUM STANNATE $K_2SnO_3 \cdot 3H_2O$.

100 gms. H_2O dissolve 106.6 gms. at 10°, and 110.5 gms. at 20°. Sp. Gr. at 10° = 1.618 at 20° = 1.627. (Ordway, 1863.)

POTASSIUM STANNATE $K_2Sn(OH)_6$ and $K_2Sn(OH)_6 \cdot 2H_2O$.

SOLUBILITY OF THE ANHYDROUS AND THE HYDRATED SALT, EACH SEPARATELY, IN WATER. (Zoeher, 1920.)

t°.	Gms. $K_2Sn(OH)_6$ per 100 gms. sat. sol.	Solid Phase.
28.....	50.7	$K_2Sn(OH)_6$
28.....	52.4	$K_2Sn(OH)_6 \cdot 2H_2O$

POTASSIUM TELLURATE K_2TeO_4 .

100 gms. H_2O dissolve 8.82 gms. K_2TeO_4 at 0°, 27.53 gms. at 20° and 50.42 gms. at 30°. (Rosenheim and Weinheber, 1910-11.)

POTASSIUM VANADATE $K_3V_6O_{14} \cdot 5H_2O$.

100 gms. H_2O dissolve 19.2 gms. at 17.5°. (Radan, 1889.)

POTASSIUM ZINC VANADATE $KZnV_6O_{14} \cdot 8H_2O$.

100 gms. H_2O dissolve 0.41 gm. of the salt (Radan).

POTASSIUM TUNGSTATE K_2WO_4

Fusion-point data are given for the following mixtures.

$K_2WO_4 + Na_2WO_4$ (Van Liempt, 1922.)
 $+ WO_3$ (Van Liempt, 1922; Hoermann, 1929.)

S10

TeO

WO)

KRYPTON Kr.

SOLUBILITY OF KRYPTON IN WATER. (von Antropoff, 1919.)

The following new determinations were made in a refined apparatus arranged so that the solvent and its vapor touched no cock. The previous determinations were found to be in error in the region of the minimum. The results are expressed in terms of the Bunsen coefficient as modified by Kuenen, that is the volume of gas in cc. (reduced to normal conditions) dissolved by 1.0 gm. of H_2O .

t°.	Absorp. coef β	t°.	Absorp. coef. β	t°.	Absorp. coef. β	t°.	Absorp. coef. β
0.....	0.1105	20.....	0.0696	40.....	0.0433	60.....	0.0357
10.....	0.0810	30.....	0.0511	50.....	0.0383		

The above determinations have been recalculated by Valentiner, 1927, and expressed in terms of the Ostwald Solubility α' which is the relation of the concentration of the gas in the liquid to the gas phase and, according to the Henry-Dalton law, is independent of the partial pressure of the gases at a given temperature.

t°	α'	t°	α'	t°	α'
0	0.1105	30	0.0565	60	0.0418
10	0.0840	40	0.0494	70	0.0403
20	0.0673	50	0.0447	80	0.0398

KRYPTON Kr

SOLUBILITY OF KRYPTON IN SEVERAL LIQUIDS, DETERMINED BY SIMPLE METHODS TO AN ACCURACY OF ABOUT 5 PERCENT.

Results of Körösy, 1937

Results of Van Liempt and Van Wijk, 1937

Solvent	t°	(Ostwald Exp.) α'	Solvent	t°	s
Ethyl Alcohol (95%)	21	0.62	Water	0.5	0.12
" " (97.5%)	21	0.67	"	20	0.06
Cyclohexanol	22	0.40	Gasoline (Benzine)	19	0.89
Acetone (technical)	19	0.83	Petroleum	20	1.00
" (dried)	20	1.05	Paraffine oil	18.5	0.60
Benzene	22	0.97	Benzene	19	0.67
Tetraline	24	0.49	Toluene	18	0.84
Butyl acetate (techn.)	20	0.85	Methyl alcohol	18	0.52
Butyl phthalate "	20	0.47	Ethyl " (96%)	19	0.51
Tricresyl phosphate "	22	0.23	Amyl "	23	0.66
Acetic acid (glacial)	22	0.47	Glycerol (100%)	22	0.01
Glycerol	20	0.06			
Chloroform	0	0.97	S = cc Kr (at 0 and 760mm.)		
"	21	1.01	dissolved by 1.0cc solvent		
Bromoform	22	0.46	under 1 atmosphere pressure		
Carbon tetrachloride	0	1.20	of Kr and vapor of solvent.		
" "	21	1.31			
Aq. 20% $CaCl_2$ Solution	22	0.04	The Krypton used in both cases		
Ar in Chloroform	22	0.178	contained about 5 percent of xenon.		

Data for the solubility of Krypton in liquid Oxygen are given by v. Stackelberg, 1934.

SOLUBILITY OF LANTHANUM IN MERCURY.

(Parks and Campanella, 1936.)

Amalgams of lanthanum and mercury were prepared by heating the mixed constituents in fused quartz flasks to 200° or by electrolysis of Lanthanum Salts dissolved in absolute ethyl alcohol with Hg as the cathode. Such amalgams were kept in evacuated fused quartz flasks at the selected temperatures, approaching equilibrium from above and below. A filtered portion of the saturated solution was allowed to stand in contact with the air until the lanthanum had separated as the hydroxide and this was then determined by titration.

t°	Gms. La per 100 gms. La + Hg	t°	Gms. La per 100 gms. La + Hg
0	0.00552	37.5	0.0134
12.5	0.00907	50.0	0.0184
25.0	0.00960		

LANTHANUM BROMATE $\text{La}(\text{BrO}_3)_3 \cdot 9\text{H}_2\text{O}$.

BrO

SOLUBILITY OF LANTHANUM BROMATE IN WATER.

(James, Fogg, McIntire, Evans and Donovan, 1927.)

t°	Gms. per 100 gms. sat. sol.		t°	Gms. per 100 gms. sat. sol.	
	$\text{La}(\text{BrO}_3)_3$	$\text{La}(\text{BrO}_3)_3 \cdot 9\text{H}_2\text{O}$		$\text{La}(\text{BrO}_3)_3$	$\text{La}(\text{BrO}_3)_3 \cdot 9\text{H}_2\text{O}$
0	49.48	64.83	20	59.83	78.40
5	52.06	68.22	25	62.74	82.21
10	54.59	71.53	30	66.63	87.31
15	57.02	74.89	35	69.74	91.38

LANTHANUM ACETATE $\text{La}(\text{CH}_3\text{COO})_3 \cdot 1\frac{1}{2}\text{H}_2\text{O}$.

100 gms. H_2O dissolve 20.43 gms. $\text{La}(\text{CH}_3\text{COO})_3$ at 18°. (Vesterberg, 1916, 1917.)
 " " " 16.88 " " " 25°. (Meyer and Muller, 1920.)

100 gms. Methyl Alcohol dissolve 0.64 gm. $\text{La}(\text{CH}_3\text{COO})_3$ at 15° and
 0.77 gms. at 66° (b.pt.). (Henstock, 1934.)

LANTHANUM CITRATE $2(\text{LaC}_2\text{H}_3\text{O}_4) \cdot 7\text{H}_2\text{O}$.

100 gms. aq. citric solution containing 10 gms. citric acid per 100 cc., dissolve
 0.8 gm. $\text{La}(\text{C}_6\text{H}_5\text{O}_4)_3$ at 20°. (Holmberg, 1907.)

CH

LANTHANUM GLYCOLATE $\text{La}(\text{C}_2\text{H}_3\text{O}_3)_3$.

One liter H_2O dissolves 3.328 gms. $\text{La}(\text{C}_2\text{H}_3\text{O}_3)_3$ at 20°. (Jantsch and Grunkraut, 1912-13.)

LANTHANUM MALONATE $\text{La}_2(\text{C}_3\text{H}_2\text{O}_4)_3 \cdot 5\text{H}_2\text{O}$.

100 gms. aq. Am. malonate sol. (10 gms. per 100 cc.) dissolve 0.2 gm. $\text{La}_2(\text{C}_3\text{H}_2\text{O}_4)_3$
 100 gms. aq. malonic acid sol. (20 gms. per 100 cc.) dissolve 0.6 gm. " at 20°. (Holmberg, 1907.)

LANTHANUM LACTATE $\text{La}(\text{C}_3\text{H}_5\text{O}_4)_3 \cdot 3\text{H}_2\text{O}$.

100 cc. sat. solution of lanthanum lactate in water contain 1.44 gms. La_2O_3
 [= 4.06 gms. $\text{La}(\text{C}_3\text{H}_5\text{O}_4)_3 \cdot 3\text{H}_2\text{O}$] at 20°. (Jantsch, 1926.)

LANTHANUM TARTRATE $\text{La}_2(\text{C}_4\text{H}_4\text{O}_6)_3 \cdot 9\text{H}_2\text{O}$.

One liter H_2O dissolves 0.059 gm. $\text{La}_2(\text{C}_4\text{O}_6)_3$ at 25° (solid phase $\text{La}_2(\text{C}_4\text{H}_4\text{O}_6)_3 \cdot 3\text{H}_2\text{O}$). Determined by electrolytic method. (Rimbach and Schubert, 1909.)

SOLUBILITY OF LANTHANUM TARTRATE IN AQ. TARTARIC ACID AND AMMONIUM TARTRATE SOLUTIONS AT 20° .
(Holmberg, 1907.)

In Aq. Tartaric Acid.		In Aq. Ammonium Tartrate.	
Gms. Tartaric Acid per 100 cc. Solvent.	Gms. $\text{La}_2(\text{C}_4\text{O}_6)_3$ per 100 Gms. Sat. Sol.	Gms. Am. Tartrate per 100 cc. Solvent.	Gms. $\text{La}_2(\text{C}_4\text{H}_4\text{O}_6)_3$ per 100 Gms. Sat. Sol.
20	0.6	10	0.2
40	1.2	20	0.6

LANTHANUM SULFONATES.**SOLUBILITY OF EACH IN WATER.**

Sulfonate.	Formula.	Gms. Anhydrous Sulfonate per 100 Gms. H_2O .	Authority.
Lanthanum Benzene Sulfonate	$\text{La}(\text{C}_6\text{H}_5\text{SO}_3)_3 \cdot 9\text{H}_2\text{O}$	0.3.1 (Holmberg, 1907.)	
" m Nitrobenzene Sulfonate	$\text{La}(\text{C}_6\text{H}_4\text{NO}_2\text{SO}_3)_3 \cdot 6\text{H}_2\text{O}$	16	"
" m Chlorbenzene Sulfonate	$\text{La}(\text{C}_6\text{H}_4\text{ClSO}_3)_3 \cdot 9\text{H}_2\text{O}$	13.1	"
" m Brombenzene "	$\text{La}(\text{C}_6\text{H}_4\text{BrSO}_3)_3 \cdot 9\text{H}_2\text{O}$	12.0	"
" (6) Chloro (3) Nitrobenzene (1) } Sulfo-	$\text{La}(\text{C}_6\text{H}_3\text{Cl}(\text{NO}_2)\text{SO}_3)_3 \cdot 8\text{H}_2\text{O}$	24.5	"
" (1) Bromo (4) Nitrobenzene (2) } nate	$\text{La}(\text{C}_6\text{H}_3\text{BrNO}_2\text{SO}_3)_3 \cdot 8\text{H}_2\text{O}$	5	(Katz & James, '13.)
" α Naphthalene Sulfonate	$\text{La}(\text{C}_{10}\text{H}_7\text{SO}_3)_3 \cdot 6\text{H}_2\text{O}$	5.2 (Holmberg, 1907.)	
" 1.5 Nitronaphthalene Sulfonate	$\text{La}(\text{C}_{10}\text{H}_6(\text{NO}_2)\text{SO}_3)_3 \cdot 6\text{H}_2\text{O}$	0.55	"
" 1.6 " "	" " $\cdot 9\text{H}_2\text{O}$	0.21	"
" 1.7 " "	" " $\cdot 9\text{H}_2\text{O}$	1.1	"

LANTHANUM CobaltiCYANIDE $\text{La}_2(\text{CoC}_6\text{N}_6)_3 \cdot 9\text{H}_2\text{O}$.

100 gms. aq. 10% HCl ($d_{15} = 1.05$) dissolve 10.41 gms. salt at 25° . (James and Willand, 1916.)

LANTHANUM OXALATE $\text{La}_2(\text{C}_2\text{O}_4)_3 \cdot 9\text{H}_2\text{O}$.**SOLUBILITY OF LANTHANUM OXALATE IN WATER AT 25° .**

Gms. $\text{La}_2(\text{C}_2\text{O}_4)_3$ per liter sat. solution. Determined by:				Authority
Conductivity Method	Gravimetric Method	Volumetric Method	Colorimetric Method	
0.00062	—	—	—	(Rimbach and Schubert, 1909.)
0.00070	0.00096	0.00121	—	(Hauser and Herzfeld, 1912.)
0.00206	0.00214	—	—	(Sarver and Brinton, 1927.)
0.00060	—	0.00208	0.00195	(Kolthoff and Elmquist, 1931.)

Solid Phase $\text{La}_2(\text{C}_2\text{O}_4)_3 \cdot 9\text{H}_2\text{O}$ in all cases.

100 gms. aq. 10.2% HNO_3 ($d = 1.063$) dissolve 0.80 gm. $\text{La}_2(\text{C}_2\text{O}_4)_3$ at 15° . (v. Scheele, 1899.)

100 gms. aq. 19.4% HNO_3 ($d = 1.116$) dissolve 2.69 gms. $\text{La}_2(\text{C}_2\text{O}_4)_3$ at 15° . (v. Scheele, 1899.)

SOLUBILITY OF LANTHANUM OXALATE IN AQ. SOLUTIONS OF SULFURIC ACID AT 25° . (Hauser and Wirth, 1908; Wirth, 1908; Wirth, 1912.)

Normality of H_2SO_4 .	Gms. per 100 Gms. Sat. Sol.		Solid Phase.	Normality of H_2SO_4 .	Gms. per 100 Gms. Sat. Sol.		Solid Phase.
	$\text{La}_2\text{O}_3 = \text{La}_2(\text{C}_2\text{O}_4)_3$.				$\text{La}_2\text{O}_3 = \text{La}_2(\text{C}_2\text{O}_4)_3$.		
0.1	0.0208	0.0346	$\text{La}_2(\text{C}_2\text{O}_4)_3 \cdot 9\text{H}_2\text{O}$	2	0.4417	0.7344	$\text{La}_2(\text{C}_2\text{O}_4)_3 \cdot 9\text{H}_2\text{O}$
0.5	0.0979	0.1629	"	3.09	0.680	1.1306	"
1	0.2383	0.3962	"	4.32	0.880	1.4630	"
1.5	0.319	0.5304	"	5.6	1.092	1.8155	"

SOLUBILITY OF LANTHANUM OXALATE IN AQ. SOLUTIONS OF OXALIC ACID
AT 25°. (Hauser and Wirth, 1908.)

Normality of Aq. Oxalic Acid.	Gms. per 100 Gms. Sat. Sol.		Solid Phase.
	La_2O_3	$\text{La}_2(\text{C}_2\text{O}_4)_3$	
0.1	unweighable		$\text{La}_2(\text{C}_2\text{O}_4)_3 \cdot 9\text{H}_2\text{O}$
1.0	0.00032	0.00053	"
3.2 (sat.)	0.00045	0.00075	"

Results are also given for the solubility in mixtures of sulfuric and oxalic acids.
100 cc. aq. 20% triethylamineoxalate dissolve approx. 0.032 gm. $\text{La}_2(\text{C}_2\text{O}_4)_3$.
(Grant and James, 1917.)

SOLUBILITY OF LANTHANUM OXALATE IN AQUEOUS SOLUTIONS
OF ACIDS AT 25°.

(Sarver and Brinton. 1927.)

From 50 to 1000 gms. of the saturated solutions were evaporated to dryness in small porcelain dishes and the residue converted to oxide and weighed.

Normality of Acid in Aqueous Solvent	Gms. $\text{La}_2(\text{C}_2\text{O}_4)_3$ per 100 gms. sat. sol.	Normality of Acid in Aqueous Solvent	Gms. $\text{La}_2(\text{C}_2\text{O}_4)_3$ per 100 gms. sat. sol.
0.1008 HCl	0.0208	0.2482 HNO_3	0.0354
0.2576 "	0.0567	1.992 "	0.9256
0.5004 "	0.1384	4.054 "	2.660
0.978 "	0.3074	2.00 " + 0.1 $(\text{COOH})_2$	0.3908
1.484 "	0.4937	3.03 " + 0.1 "	1.227
2.000 "	0.6770	4.00 " + 0.1 "	1.568
2.865 "	1.082	2.00 " + 0.5 "	0.1292
4.000 "	1.327	3.03 " + 0.5 "	0.3576
5.200 "	1.285	4.00 " + 0.5 "	0.7200
0.978 " + 0.1 $(\text{COOH})_2$	0.0532	4.00 " + sat. "	0.7664
2.000 " + 0.1 "	0.2998	6.00 " + sat. "	1.304
2.865 " + 0.1 "	0.6330	0.086 H_2SO_4	0.0222
3.965 " + 0.1 "	1.026	0.419 "	0.1078
0.978 " + 0.5 "	0.0062	0.958 "	0.2523
2.865 " + 0.5 "	0.1098	1.846 "	0.5128
3.965 " + 0.5 "	0.3127	2.612 "	0.6840
1.484 " + sat. "			
4.00 " + sat. "			

SOLUBILITY OF LANTHANUM OXALATE IN AQUEOUS SOLUTIONS OF NITRIC ACID
AND IN AQUEOUS OXALIC ACID SOLUTIONS OF NITRIC ACID AT 90°.

(Neckur and Kremers, 1928.)

The mixtures were frequently shaken during 36 hours. For analysis 50cc of the filtered saturated solutions were evaporated to dryness in porcelain dishes and the residues ignited and weighed as oxide.

Normality of Acid in Aqueous Solvent	Gms. La_2O_3 per 100cc sat. sol.	Normality of Acid in Aqueous 5% $(\text{COOH})_2$ Solution	Gms. La_2O_3 per 100cc sat. sol.
0.779 HNO_3	0.4421	0.779 HNO_3	0.0302
1.558 "	1.2377	1.558 "	0.3083
3.75 "	4.6670	2.337 "	0.7517
5.00 "	10.4160	3.75 "	3.5260
		5.00 "	9.3907

La LANTHANUM

890

LANTHANUM CHLORIDE LaCl_3 .

SOLUBILITY OF LANTHANUM CHLORIDE AND OF LANTHANUM OXIDE IN AQUEOUS SOLUTIONS OF AMMONIUM CHLORIDE AT 15°, 30°, 50° AND 100°. (Prandtl and Rauchenberger, 1920.)

The results are given only in the form of small scale diagrams and it is stated that the numerical data will be published in full in the dissertation of Johanna Rauchenberger, University of München, 1920. The equilibrium



was approached by the authors from both sides. The composition of the basic chlorides obtained by shaking the oxide with 1.0 N NH_4Cl at different temperatures, and drying over soda lime, was approximately as follows:

At 15°, $\text{La}_2\text{Cl}_2\text{O}_{3.9}\text{H}_2\text{O}$; at 30°, $\text{La}_2\text{Cl}_2\text{O}_{4.6}\text{H}_2\text{O}$; at 50°, $\text{La}_2\text{Cl}_2\text{O}_{5.16}\text{H}_2\text{O}$.

LANTHANUM Hexa Antipyrine Per CHLORATE $[\text{La}(\text{COC}_{10}\text{H}_{12}\text{N}_2)_6](\text{ClO}_4)_3$

100cc sat. solution of Lanthanum Hexa Antipyrine Perchlorate in Water contain 1.48 gm. $[\text{La}(\text{COC}_{10}\text{H}_{12}\text{N}_2)_6](\text{ClO}_4)_3$ at 20°. (Wilke-Dörfurt and Schliephake, 1928.)

LANTHANUM CHROMATE $\text{La}_2(\text{CrO}_4)_3 \cdot 8\text{H}_2\text{O}$.

100 gms. sat. solution of Lanthanum Chromate in Water contain 0.020 gm. $\text{La}_2(\text{CrO}_4)_3$ at 25°. (Britton, 1924.)

LANTHANUM Potassium CHROMATE.

The system $\text{La}_2(\text{CrO}_4)_3 + \text{K}_2\text{CrO}_4 + \text{H}_2\text{O}$ at 25° was studied by Carobbi, 1924, but the table of results does not show the quantity of $\text{La}_2(\text{CrO}_4)_3$ present in the solutions. The results show the several double compounds formed.

LANTHANUM Hexa Antipyrine IODIDE $[\text{La}(\text{COC}_{10}\text{H}_{12}\text{N}_2)_6]\text{I}_3$

100cc sat. solution of Lanthanum Hexa Antipyrine Iodide in Water contain 29.50 gm. $[\text{La}(\text{COC}_{10}\text{H}_{12}\text{N}_2)_6]\text{I}_3$ at 20°. (Wilke-Dörfurt and Schliephake, 1928.)

LANTHANUM IODATE $\text{La}(\text{IO}_3)_3$.

SOLUBILITY IN WATER AND IN Aq. SALT SOLUTIONS AT 25°. (Harkins and Pearce, 1916)

1000 gms. H_2O dissolve 0.6842 gm. $\text{La}(\text{IO}_3)_3$ at 25°, $d_{25}^{\text{sat. sol.}} = 0.99825$.

IO	La				Na			
	Salt.	Conc. of Salt, Milli-Normal.	Gms. $\text{La}(\text{IO}_3)_3$ per Liter.	$d_{25}^{\text{sat. sol.}}$	Salt.	Conc. of Salt, Milli-Normal.	Gms. $\text{La}(\text{IO}_3)_3$ per Liter.	$d_{25}^{\text{sat. sol.}}$
	$\text{La}(\text{NO}_3)_3$	2	0.5595	0.99732	NaNO_3	25	0.86901	1.00250
	"	5	0.5288	0.99807	"	50	0.90040	1.00385
	"	10	0.5194	0.99850	"	100	1.1603	1.00742
	"	50	0.5522	1.00212	"	200	1.385	1.01290
	"	100	0.6214	1.00601	"	400	1.636	1.02422
	"	200.52	0.7431	1.01533	"	800	2.156	1.04677
	KIO_3	0.0990	0.6290	1.00030	"	1600	2.859	1.09005
	"	0.4957	0.5633	1.00027	"	3200	3.030	1.17243
	"	0.9914	0.4970	1.00030	$\text{La}(\text{NO}_3)_3 \cdot 2\text{NH}_4\text{NO}_3$			
	"	1.9828	0.3738	1.00031				
	NaIO_3	0.0913	0.63538	1.00060	"	52.68	0.674	1.00355
	"	0.4560	0.56466	1.00059	"	105.36	0.754	1.00971
	"	0.9130	0.50835	1.00065	"	158.04	0.816	1.01608
	"	1.8260	0.39938	1.00065	"	196.83	0.807	1.02183
	"	3.6530	0.19736	1.00060	"	393.67	1.003	1.04343
	"	4.5326	0.13393	1.00083	"	787.35	1.364	1.08286
	"	6.7989	0.09733	1.00130	"	1574.70	1.923	1.16652

According to Rimbach and Schubert (1909), one liter H_2O dissolves 1.681 gms. $\text{Li}(\text{IO}_3)_3$ at 25°, determined chemically, and 1.871 gms. determined electrolytically; solid phase, $2\text{La}(\text{IO}_3)_3 \cdot 3\text{H}_2\text{O}$.

SOLUBILITY OF LANTHANUM IODATE IN WATER AND IN AQUEOUS
SALT SOLUTIONS AT 25°.

(Lamer and Goldman, 1929; Friedman and La Mer, 1931.)

The solubility of lanthanum iodate in water varied with different samples from 0.00089 to 0.00094 gm. mols. per liter (= 0.5907 to 0.6333 gms. $\text{La}(\text{IO}_3)_3$ per liter).

Mols. salt per liter of Aq. Solvent	Mols. $\text{La}(\text{IO}_3)_3$ per liter sat. solution	Mols. salt per liter of Aq. Solvent	Mols. $\text{La}(\text{IO}_3)_3$ per liter sat. solution
0.0002 K_2SO_4	0.0009167	0.001 KCl	0.0009113
0.0005 "	0.0009746	0.005 "	0.0009740
0.0010 "	0.0010564	0.010 "	0.0010322
0.0020 "	0.0012153	0.05 "	0.0013331
0.0070 "	0.0016852	0.10 "	0.0015713
0.0125 "	0.0020272	0.10 "	0.0016480
0.02 "	0.0023675	0.20 "	0.0018776
0.05 "	0.0031871	0.50 "	0.0025641
0.05 "	0.003370	1.0027 "	0.0030547
0.10 KNO_3	0.001679	2.00 "	0.0037828
0.10 NaNO_3	0.001654	0.05 Na_2SO_4	0.003326
0.10 NaCl	0.001627	0.0333 $\text{La}_2(\text{SO}_4)_3$	0.001830
0.033 LaCl_3	0.0009233	0.0166 "	0.001532

Mols. salt per liter of Aq. Solvent	Mols. $\text{La}(\text{IO}_3)_3$ per liter sat. solution
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0.00166 $\text{La}(\text{NO}_3)_3$	0.0008347
0.00333 "	0.0008101
0.0166 "	0.0008696
0.0333 "	0.0009398
0.050 $\text{Mg}(\text{NO}_3)_2$	0.001766
0.05 MgCl_2	0.001768
0.05 "	0.001739
0.05 MgSO_4	0.003010
0.05 "	0.002997
0.05 CdCl_2	0.001689
0.05 CdSO_4	0.003205

LANTHANUM MOLYBDATE $\text{La}_2(\text{MoO}_4)_3$.

One liter H_2O dissolves 0.0179 gm. $\text{La}_2(\text{MoO}_4)_3$ at 25° and 0.0332 gm. $\text{La}_2(\text{MoO}_4)_3$ at 85°. (Hitchcock, 1895.)

EQUILIBRIUM IN THE SYSTEM LANTHANUM MOLYBDATE, SODIUM
MOLYBDATE AND WATER AT 25°.

(Carobbi, 1928.)

Gms. per 100 gms. sat. sol.	Solid	Gms. per 100 gms. sat. sol.	Solid
Na_2MoO_4	Phase	$\text{La}_2(\text{MoO}_4)_3$	Phase
0.77	$\text{La}_2(\text{MoO}_4)_3$. aq. + 1.1.2	15.50	1.2.3
2.44	0.02 1.1.2	16.19	0.19 "
2.92	0.03 "	20.02	0.25 "
7.56	0.08 "	22.35	0.28 "
11.50	0.13 "	25.26	0.34 "
11.54	0.13 " + 1.2.3	25.27	0.34 " + Na_2MoO_4
11.52	0.13 1.2.3		2H ₂ O

1.1.2 = $\text{La}_2(\text{MoO}_4)_3 \cdot \text{Na}_2\text{MoO}_4 \cdot 2\text{H}_2\text{O}$; 1.2.3 = $\text{La}_2(\text{MoO}_4)_3 \cdot 2\text{Na}_2\text{MoO}_4 \cdot 3\text{H}_2\text{O}$

LANTHANUM NITRATES α and β $\text{La}(\text{NO}_3)_3 \cdot 6\text{H}_2\text{O}$.

SOLUBILITY OF LANTHANUM NITRATES IN WATER.

(Friend, 1935.)

t°	Gms. $\text{La}(\text{NO}_3)_3$ per 100 gms. sat. sol.	Solid Phase	t°	Gms. $\text{La}(\text{NO}_3)_3$ per Solid 100 gms. sat. sol. Phase
0	50.03	$\alpha \text{La}(\text{NO}_3)_3 \cdot 6\text{H}_2\text{O}$	16.0	56.74 $\beta \text{La}(\text{NO}_3)_3 \cdot 6\text{H}_2\text{O}$
18.4	54.16	"	23.2	58.7 "
21.2	55.03	"	29.6	60.08 "
35.4	59.12	"	32.2	61.34 "
42.4	63.84	"	40.0	62.71 "
44.2	65.13	"	46.4	65.55 "
43.0 tr.pt.	—	" + $\beta \text{La}(\text{NO}_3)_3 \cdot 6\text{H}_2\text{O}$	49.4	65.17 "
14.4	56.27	$\beta \text{La}(\text{NO}_3)_3 \cdot 6\text{H}_2\text{O}$	56.0	68.30 "
15.2	56.94	"	65.4 m.pt.	75.04 "

SOLUBILITY OF LANTHANUM NITRATE IN AQUEOUS SOLUTIONS OF NITRIC ACID.

(Quill and Robey, 1937.)

Results at 25°

d. of sat. sol.	Gms. per 100 gms. sat. sol. $\text{La}(\text{NO}_3)_3$	HNO_3	Solid Phase
—	59.0	0.0	$\text{La}(\text{NO}_3)_3 \cdot 6\text{H}_2\text{O}$
1.771	56.42	3.06	"
—	46.42	11.95	"
—	29.10	34.69	"
—	29.62	40.17	$\text{La}(\text{NO}_3)_3 \cdot 4\text{H}_2\text{O}$
—	28.73	41.14	"
—	25.18	54.41	"
—	21.61	58.36	"
1.489	2.79	70.70	$\text{La}(\text{NO}_3)_3 \cdot 3\text{H}_2\text{O}$
—	0.56	87.85	$\text{La}(\text{NO}_3)_3$
1.483	0.0	90.0	None

Results at 50°

1.929	66.65	0.0	$\text{La}(\text{NO}_3)_3 \cdot 6\text{H}_2\text{O}$
1.912	61.21	2.59	"
1.892	61.85	5.29	"
1.852	56.70	12.05	"
1.880	56.34	14.93	" + $\text{La}(\text{NO}_3)_3 \cdot 4\text{H}_2\text{O}$
1.755	44.23	27.73	$\text{La}(\text{NO}_3)_3 \cdot 4\text{H}_2\text{O}$
1.645	30.31	44.48	"
—	29.58	50.53	"
—	5.48	78.31	$\text{La}(\text{NO}_3)_3 (?)$
—	1.38	85.51	"
1.419	0.41	91.15	"
1.440	0.0	90.0	None

LANTHANUM NITRATE $\text{La}(\text{NO}_3)_3$.

SOLUBILITY OF LANTHANUM NITRATE IN AQUEOUS SOLUTIONS OF LANTHANUM OXALATE AT 25° AND VICE VERSA. (James and Whittemore, 1912.)

Gms. per 100 Gms. Sat. Sol.		Solid Phase.	Gms. per 100 Gms. Sat. Sol.		Solid Phase.
$\text{La}_2(\text{C}_2\text{O}_4)_3$	$\text{La}(\text{NO}_3)_3$		$\text{La}_2(\text{C}_2\text{O}_4)_3$	$\text{La}(\text{NO}_3)_3$	
0	60.17	$\text{La}(\text{NO}_3)_3$	not det.	not det.	$\text{La}_2(\text{C}_2\text{O}_4)_3 \cdot 5\text{H}_2\text{O}$
0.67	59.91	"	3.32	42.27	$\text{La}_2(\text{C}_2\text{O}_4)_3 \cdot 8\text{H}_2\text{O}$
2.10	59.03	"	2.80	38.50	"
2.23	59.03	" + $\text{La}_2(\text{C}_2\text{O}_4)_3 \cdot 3\text{H}_2\text{O}$	2.51	35.57	"
2.26	58.22	$\text{La}_2(\text{C}_2\text{O}_4)_3 \cdot 3\text{H}_2\text{O}$	2.21	31.53	"
2.34	55.20	"	2.01	28.63	"
2.47	52.74	"	1.46	22.15	"
2.59	49.84	"	1.18	17.99	"
2.68	45.26	"	0.50	9.89	"
not det.	not det.	$\text{La}_2(\text{C}_2\text{O}_4)_3 \cdot 5\text{H}_2\text{O}$	0.28	5.06	"

SOLUBILITY OF LANTHANUM NITRATE IN AQUEOUS SOLUTIONS OF MAGNESIUM NITRATE AND VICE VERSA AT 20°.

(Di Capua, 1909.)

Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase
$\text{La}(\text{NO}_3)_3$	$\text{Mg}(\text{NO}_3)_2$		$\text{La}(\text{NO}_3)_3$	$\text{Mg}(\text{NO}_3)_2$	
60.13	0	$\text{La}(\text{NO}_3)_3 \cdot 6\text{H}_2\text{O}$	26.0	24.0	$\text{La}(\text{NO}_3)_3 \cdot 6\text{H}_2\text{O}$
58.91	2.20	"	22.90	25.48	$\text{Mg}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$
55.06	6.21	"	15.35	30.93	"
50.11	9.83	"	6.89	36.30	"
42.98	17.40	"	3.20	39.25	"
37.02	19.25	"	0.0	43.68	"

SOLUBILITY OF LANTHANUM NITRATE IN AQUEOUS SOLUTIONS OF MANGANESE NITRATE AND VICE VERSA AT 20°.

(Di Capua, 1929.)

Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase
$\text{La}(\text{NO}_3)_3$	$\text{Mn}(\text{NO}_3)_2$		$\text{La}(\text{NO}_3)_3$	$\text{Mn}(\text{NO}_3)_2$	
60.13	0.0	$\text{La}(\text{NO}_3)_3 \cdot 6\text{H}_2\text{O}$	24.70	26.80	$\text{Mn}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$
53.90	5.08	"	22.95	27.50	"
49.20	8.91	"	21.25	29.18	"
41.45	13.22	"	14.15	41.10	"
36.82	16.19	"	10.00	45.00	"
29.81	21.00	"	6.22	49.20	"
27.45	21.95	"	0.0	58.81	"

LANTHANUM Magnesium NITRATE $2\text{La}(\text{NO}_3)_3 \cdot 3\text{Mg}(\text{NO}_3)_2 \cdot 24\text{H}_2\text{O}$.

SOLUBILITY OF LANTHANUM MAGNESIUM NITRATE IN WATER.

(Friend and Wheat, 1935.)

t°	Gms. $2\text{La}(\text{NO}_3)_3 \cdot 3\text{Mg}(\text{NO}_3)_2 \cdot 24\text{H}_2\text{O}$ per 100 gms. sat. solution	t°	Gms. $2\text{La}(\text{NO}_3)_3 \cdot 3\text{Mg}(\text{NO}_3)_2 \cdot 24\text{H}_2\text{O}$ per 100 gms. sat. solution
18.6	62.19	61.4	73.05
31.6	63.96	74.8	77.43
46.8	68.57	113.5 (m.pt.)	100.00
50.8	70.17		

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LANTHANUM Ammonium **NITRATE** $\text{La}(\text{NO}_3)_3 \cdot 2\text{NH}_4\text{NO}_3$.

100 gms. H_2O dissolve 181.4 gms. $\text{La}(\text{NO}_3)_3 \cdot 2\text{NH}_4\text{NO}_3$ at 15° . (Holmberg, 1907.)

LANTHANUM Double **NITRATES**.

SOLUBILITY OF LANTHANUM DOUBLE NITRATES IN CONC. HNO_3 ($d_{15} = 1.325$) AT 16° . (Jantsch, 1912.)

Salt.	Formula.	Gms. Hydrated Salt Dissolved per Liter Sat. Sol.
Lanthanum Magnesium Nitrate	$[\text{La}(\text{NO}_3)_3]_2\text{Mg}_3 \cdot 24\text{H}_2\text{O}$	63.8
" Nickel "	" Ni_3 "	80.3
" Cobalt "	" Co_3 "	109.2
" Zinc "	" Zn_3 "	124.1
" Manganese "	" Mn_3 "	193.1

100cc. of a saturated solution of $\text{La}(\text{NO}_3)_3 \cdot 6\text{H}_2\text{O}$ in Ethyl Ether prepared by frequent agitation and allowing to stand over night at about 20° contain 0.002 gm. La_2O_3 . A saturated ethereal solution prepared as above but using Lanthanum nitrate dehydrated at 150° contain only 0.001 gm. La_2O_3 per 100cc. (Wells, 1930.)

Fusion-point data for mixtures of $\text{La}(\text{NO}_3)_3$ + $\text{Mg}(\text{NO}_3)_2$ are given by Quill and Robey, 1937.

LANTHANUM OXIDE La_2O_3 .

SOLUBILITY OF LANTHANUM OXIDE IN WATER.

t°	Milligrams La_2O_3 per liter sat. sol.	Method	Authority
18	0.405	Potentiometric	Sadolin, 1927.)
25	0.40	Volumetric	Bush, 1927.
25	0.73	Volumetric	Kolthoff and Elmquist,
25	0.3-0.67	Conductivity	" 1931.

LANTHANUM Dimethyl **PHOSPHATE** $\text{La}_2[(\text{CH}_3)_2\text{PO}_4]_6 \cdot 6\text{H}_2\text{O}$.

100 gms. H_2O dissolve 193.7 gms. $\text{La}_2[(\text{CH}_3)_2\text{PO}_4]_6$ at 25° . (Morgan and James, 1914.)

LANTHANUM SULFATE $\text{La}_2(\text{SO}_4)_3 \cdot 9\text{H}_2\text{O}$.

SOLUBILITY IN WATER. (Muthmann and Röllig, 1898.)

t°	Gms. $\text{La}_2(\text{SO}_4)_3$ per 100 Gms.		t°	Gms. $\text{La}_2(\text{SO}_4)_3$ per 100 Gms.	
	Solution.	Water.		Solution.	Water.
0	2.91	3	50	1.47	1.5
14	2.53	2.6	75	0.95	0.96
30	1.86	1.9	100	0.68	0.69

SOLUBILITY OF LANTHANUM SULFATE IN Aq. SOLUTIONS OF AMMONIUM SULFATE, POTASSIUM SULFATE AND SODIUM SULFATE. (Barre, 1910, 1911.)

In Aq. $(\text{NH}_4)_2\text{SO}_4$ at 18° .			In Aq. K_2SO_4 at 16.5° .			In Aq. Na_2SO_4 at 18° .		
Gms. per 100 Gms. H_2O .	Gms. $\text{La}_2(\text{SO}_4)_3$.	Solid Phase.	Gms. per 100 Gms. H_2O .	Gms. $\text{La}_2(\text{SO}_4)_3$.	Solid Phase.	Gms. per 100 Gms. H_2O .	Gms. $\text{La}_2(\text{SO}_4)_3$.	Solid Phase.
4.01	0.393	1.1.2	0	2.198	1.0.9	0	2.130	1.0.9
8.73	0.279	"	0.247	0.727	1.1.2	0.305	0.997	1.1.2
18.24	0.253	"	0.496	0.269	"	0.689	0.353	"
27.89	0.476*	"	0.846	0.185	"	0.774	0.299	"
36.11	0.277*	"	1.029	0.054	1.5	1.136	0.120	"
47.49	0.137	2.5	1.156	0.022	"	2.480	0.044	"
53.82	0.067	1.5				3.802	0.019	"
65.29	0.0117	"				5.548	0.016	"
73.78	0.0033	"						

* = unstable equilibrium.

1.0.9 = $\text{La}_2(\text{SO}_4)_3 \cdot 9\text{H}_2\text{O}$, 1.1.2 = $\text{La}_2(\text{SO}_4)_3 \cdot \text{X} \cdot 5\text{H}_2\text{O}$ (where $\text{X} = (\text{NH}_4)$, K or Na), 2.5 = $2\text{La}_2(\text{SO}_4)_3 \cdot 5(\text{NH}_4)_2\text{SO}_4$, 1.5 = $\text{La}_2(\text{SO}_4)_3 \cdot 5\text{X}_2\text{SO}_4$.

SOLUBILITY OF LANTHANUM SULFATE IN AQUEOUS SOLUTIONS OF SULFURIC
ACID AT 25°. (Wirth, 1912.)

Normality of Aq. H ₂ SO ₄	Gms. per 100 Gms. Sat. Sol. La ₂ O ₃ = La ₂ (SO ₄) ₃	Solid Phase.	Normality of Aq. H ₂ SO ₄	Gms. per 100 Gms. Sat. Sol. La ₂ O ₃ = La ₂ (SO ₄) ₃	Solid Phase.
Water	1.43 2.483	La ₂ (SO ₄) ₃ ·9H ₂ O	4.321	1.11 1.927	La ₂ (SO ₄) ₃ ·9H ₂ O
0.505	1.69 2.934	"	6.685	0.531 0.9217	"
1.10	1.796 3.118	"	9.68	0.266 0.4617	"
2.16	1.818 3.156	"	12.60	0.214 0.371	"
3.39	1.42 2.465	"	15.15	0.177 0.307	"

Data for the solubility of lanthanum sulfate in aq. H₂SO₄ in presence of solid oxalic acid at 25° are given by Wirth, 1908.

LANTHANUM Ammonium SULFATES.

EQUILIBRIUM IN THE SYSTEM LANTHANUM SULFATE, AMMONIUM SULFATE
AND WATER AT 25°. (Zambonini and Stolff, 1926.)

Gms. per 100 gms. sat. sol.			Gms. per 100 gms. sat. sol.		
La ₂ (SO ₄) ₃	(NH ₄) ₂ SO ₄	Solid Phase.	La ₂ (SO ₄) ₃	(NH ₄) ₂ SO ₄	Solid Phase.
0.88	6.24	La ₂ (SO ₄) ₃ ·9H ₂ O+1.1.2	0.22	29.37	1.3
0.88	6.26	1.1.2	0.19	30.40	1.5
0.75	7.19	"	0.05	33.6	"
0.73	11.11	"	0.05	36.85	"
0.34	14.48	"	0.02	39.24	" +1.6
0.32	22.89	"	0.02	42.48	1.6
0.30	22.80	" +1.3	0.02	43.24	"
0.28	25.12	1.3	0.00	44.64	1.6 + (NH ₄) ₂ SO ₄
0.26	27.97	"			
1.1.2 = La ₂ (SO ₄) ₃ ·(NH ₄) ₂ SO ₄ ·2H ₂ O;			1.5 = La ₂ (SO ₄) ₃ ·5(NH ₄) ₂ SO ₄ ;		
1.3 = La ₂ (SO ₄) ₃ ·3(NH ₄) ₂ SO ₄ ;			1.6 = La ₂ (SO ₄) ₃ ·6(NH ₄) ₂ SO ₄ ;		

LANTHANUM Potassium SULFATES.

EQUILIBRIUM IN THE SYSTEM LANTHANUM SULFATE, POTASSIUM SULFATE
AND WATER AT 25°. (Zambonini and Carobbi, 1924.)

Gms. per 100 gms. sat. sol.			Gms. per 100 gms. sat. sol.		
La ₂ (SO ₄) ₃	K ₂ SO ₄	Solid Phase.	La ₂ (SO ₄) ₃	K ₂ SO ₄	Solid Phase.
0.87	0.23	1.1.2	0.00	1.51	1.4.1
0.77	0.23	"	0.00	4.24	"
0.41	0.45	"	0.00	4.78	1.4 1/2.2
0.28	0.79	2.3.8	0.00	10.16	"
0.26	0.74	" +1.3	0.00	11.11	1.5.2
0.24	0.87	1.3	0.00	11.02	" +K ₂ SO ₄
0.00	1.62	" +1.4.1			
1.1.2 = La ₂ (SO ₄) ₃ ·K ₂ SO ₄ ·2H ₂ O;			1.4.1 = La ₂ (SO ₄) ₃ ·4K ₂ SO ₄ ·H ₂ O;		
2.3.8 = 2La ₂ (SO ₄) ₃ ·3K ₂ SO ₄ ·8H ₂ O;			1.4 1/2.2 = La ₂ (SO ₄) ₃ ·4 1/2K ₂ SO ₄ ·2H ₂ O;		
1.3 = La ₂ (SO ₄) ₃ ·3K ₂ SO ₄ ;			1.5.2 = La ₂ (SO ₄) ₃ ·5K ₂ SO ₄ ·2H ₂ O.		

LANTHANUM Sodium SULFATE.

EQUILIBRIUM IN THE SYSTEM LANTHANUM SULFATE, SODIUM SULFATE
AND WATER AT 23°. (Zambonini and Carobbi, 1925a.)

Gms. per 100 gms. sat. sol.		Solid Phase.	Gms. per 100 gms. sat. sol.		Solid Phase.
$\text{La}_2(\text{SO}_4)_3$	Na_2SO_4		$\text{La}_2(\text{SO}_4)_3$	Na_2SO_4	
0.19	0.54	$\text{La}_2(\text{SO}_4)_3 \cdot \text{Na}_2\text{SO}_4 \cdot 2\text{H}_2\text{O}$	0.0	10.46	$\text{La}_2(\text{SO}_4)_3 \cdot \text{Na}_2\text{SO}_4 \cdot 2\text{H}_2\text{O}$
0.09	0.75	"	0.0	13.86	"
Trace	3.42	"	0.0	15.06	"
"	5.43	"	0.0	16.28	"
"	7.13	"	0.0	18.06	" + Na_2SO_4

LANTHANUM Thallium SULFATES.

EQUILIBRIUM IN THE SYSTEM LANTHANUM SULFATE, THALLIUM SULFATE
AND WATER AT 23°. (Zambonini and Carobbi, 1925.)

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Gms. per 100 gms. sat. sol.		Solid Phase.	Gms. per 100 gms. sat. sol.		Solid Phase.
$\text{La}_2(\text{SO}_4)_3$	Tl_2SO_4		$\text{La}_2(\text{SO}_4)_3$	Tl_2SO_4	
1.84	0.19	$\text{La}_2(\text{SO}_4)_3 \cdot 9\text{H}_2\text{O} + 1.1.2$	0.15	1.89	1.3
1.19	0.14	1.1.2	0.16	2.01	" + 1.4 1/2
0.29	0.49	"	0.17	2.05	1.4 1/2
0.19	0.84	"	0.12	2.37	"
0.15	1.27	"	—	3.19	"
0.11	1.75	" 1.3	—	4.07	"
0.27	1.71	" "	—	5.25	"
0.25	1.75	1.3	—	5.16	" + Tl_2SO_4
0.26	1.82	"	—	5.28	" "

1.1.2 = $\text{La}_2(\text{SO}_4)_3 \cdot \text{Tl}_2\text{SO}_4 \cdot 2\text{H}_2\text{O}$; 1.3 = $\text{La}_2(\text{SO}_4)_3 \cdot 3\text{Tl}_2\text{SO}_4$;LANTHANUM SELENATE 1. 1 1/2 = $\text{La}_2(\text{SO}_4)_3 \cdot 1 1/2 \text{TiSO}_4$.

SOLUBILITY OF LANTHANUM SELENATE IN WATER.

(Friend, 1937.)

SeO

t°	Gms. $\text{La}_2(\text{SeO}_4)_3$ per 100 gms. sat. sol.	Solid Phase	t°	Gms. $\text{La}_2(\text{SeO}_4)_3$ per 100 gms. sat. sol.	Solid Phase
0.0	33.55	$\text{La}_2(\text{SeO}_4)_3 \cdot \text{A}_4$	46.2	27.54	$\text{La}(\text{SeO}_4)_3 \cdot 12\text{H}_2\text{O}$
9.6	30.90	"	51.4	23.77	"
15.0	30.84	"	59.4	15.92	"
21.8	31.31	"	69.4	8.51	"
25.4	30.54	"	78.2	5.02	"
33.6	31.29	"	81.2	3.78	"
40.6	31.15	"	92.4	1.93	"
36.4	34.00*	$\text{La}_2(\text{SeO}_4)_3 \cdot 12\text{H}_2\text{O}$	93.4	1.97	"

* Metastable

SOLUBILITY OF LANTHANUM SELENATE IN AQUEOUS SOLUTIONS OF SELENIC ACID.

(Friend, 1937.)

t°	Gms. per 100 gms. sat. sol.		Solid Phase	t°	Gms. per 100 gms. sat. sol.		Solid Phase
	H_2SeO_4	$\text{La}_2(\text{SeO}_4)_3$			H_2SeO_4	$\text{La}_2(\text{SeO}_4)_3$	
35	0	31.2	$\text{La}_2(\text{SeO}_4)_3 \cdot \text{A}_4$	83.6	0	3.25	$\text{La}_2(\text{SeO}_4)_3 \cdot 12\text{H}_2\text{O}$
"	2.08	28.96	"	"	1.68	4.81	"
"	7.80	24.07	"	"			"

LANTHANUM TUNGSTATE $\text{La}_2(\text{WO}_4)_3$.One liter H_2O dissolves 0.0117 gm. $\text{La}_2(\text{WO}_4)_3$ at 27° and 0.0236 at 65°.
(Hitchcock, 1895.)

LITHIUM Li

SOLUBILITY OF LITHIUM IN LIQUID AMMONIA, DETERMINED
BY VAPOR PRESSURE MEASUREMENTS.

(Johnson & Piskur, 1933.)

The vapor pressures of solutions of lithium in liquid ammonia at constant temperature give a curve which intersects the horizontal line representing the vapor pressure of the saturated solution. This point was determined at several temperatures with results showing that, contrary to the determinations of Ruff and Geisel, 1906, a slight increase in concentration of lithium in liquid ammonia occurs with increasing temperature.

t°	Vapor Pressure mm. Hg.	Mols. NH ₃ per atom Li	Gms. Li per 100 gms. NH ₃
-63.5	1.1	3.81	10.698
-33.2	3.4	3.75	10.866
-32.7	3.4	3.74	10.895
0.0	34.0	3.60	11.319

LITHIUM ALUMINATE $\text{LiH}(\text{AlO}_2)_2 \cdot 5\text{H}_2\text{O}$.

One liter sat. solution of $\text{LiH}(\text{AlO}_2)_2 \cdot 5\text{H}_2\text{O}$ in water contains 0.00012 gm. equivalents at 25°, 0.00013 at 50° and 0.00033 at 80° as determined by electrical conductivity. (Prociv, 1929.)

LITHIUM ARSENITE LiAsO_2 .

EQUILIBRIUM IN THE SYSTEM LITHIUM OXIDE, ARSENIC TRIOXIDE AND WATER
AT 25°. (Schreinemakers and de Baat, 1920.)

Four to six weeks constant agitation were required for saturation.

Gms. per 100 gms. sat. sol.		Solid Phase.	Gms. per 100 gms. sat. sol.		Solid Phase
Li ₂ O.	As ₂ O ₃ .		Li ₂ O.	As ₂ O ₃ .	
0.0	2.02	As ₂ O ₃	5.36	6.32	LiAsO ₂
0.45	6.45	"	6.45	6.98	"
0.84	10.26	LiAsO ₂	7.35	7.47	"
0.89	3.74	"	7.64	7.50	" + LiOH.H ₂ O
2.26	4.19	"	7.61	3.81	LiOH.H ₂ O
4.24	5.65	"	7.15	0.0	"

LITHIUM BORATE (Meta) $\text{LiBO}_2 \cdot 8\text{H}_2\text{O}$.

SOLUBILITY OF LITHIUM META BORATE IN WATER.

(Rosenheim and Reglin, 1921; Nenzel, 1927.)

t°	Gms. LiBO ₂ per 100 gms. sat. sol.	Solid Phase	t°	Gms. LiBO ₂ per 100 gms. sat. sol.	Solid Phase
-0.515	0.78	Ice + LiBO ₂ ·8H ₂ O	25.6	3.42	LiBO ₂ ·8H ₂ O
0.0	0.89	LiBO ₂ ·8H ₂ O	38.8	9.42	"
18.0	2.203	"	44.8	14.7	"
25.0	3.344	"	47. m.pt.	—	"

Li LITHIUM

EQUILIBRIUM IN THE SYSTEM LITHIUM OXIDE, BORIC OXIDE, WATER AT 30°.
(Dukelski, 1907.)

Gms. per 100 Gms. Sat. Sol.		Solid Phase.	Gms. per 100 Gms. Sat. Sol.		Solid Phase.
Li ₂ O.	B ₂ O ₃ .		Li ₂ O.	B ₂ O ₃ .	
7.01	...	LiOH.H ₂ O	1.32	3.36	Li ₂ O.2B ₂ O ₃ .xH ₂ O
7.51	2.98	"	0.86	2.47	"
7.71	3.38	" + Li ₂ O.B ₂ O ₃ .16H ₂ O	0.53	2.47	"
7.68	3.56	Li ₂ O.B ₂ O ₃ .16H ₂ O	2.17	13.12	"
5.40	2.78	"	2.61	16.30	"
3.47	2.42	"	5.08	30.81	Li ₂ O.5B ₂ O ₃ .10H ₂ O
2.94	2.51	"	4.10	27.07	"
1.58	3.27	"	3.22	15.40	"
2.17	6.90	"	1.55	15.40	"
3.66	14.78	"	1.30	14.14	"
5.25	22	"	0.06	11.47	B(OH) ₃
5.63	23.8	"	0.63	4.85	"
1.81	6.20	Li ₂ O.2B ₂ O ₃ .xH ₂ O	0	3.54	"

BO

LITHIUM Per BORATE Li₂B₂O₅.2H₂O.

100cc water dissolve 10.13 gm. lithium per borate at ordinary temperature. (Bezner-Löwy, 1923.)

Fusion-point data are given for:

LiBO₂ + LiF (Kitaigorodski, Popowa and Rotwinkin, 1933.)
 " + Li₂SiO₃ (Klooster, 1910-11.)
 " + NaBO₂ "

LITHIUM BROMIDE LiBr.2H₂O.

SOLUBILITY IN WATER.

(Kremers, 1858; Bogorodsky, 1894; Jones, 1907.)

°.	Gms. LiBr per 100 Gms. H ₂ O.		Solid Phase.	°.	Gms. LiBr per 100 Gms. H ₂ O.		Solid Phase.
— 0.46	1.058		Ice (J)	10	166		LiBr.2H ₂ O (K)
— 1.94	4.274		"	20	177		"
— 4.27	8.678		"	30	191		"
— 10.3	17.80		"	40	205		"
— 30.5	37.64		"	44	200		" + LiBr.H ₂ O (B)
— 45	50		" + LiBr.3H ₂ O	50	214		LiBr.H ₂ O (K)
— 30	80	LiBr.3H ₂ O	"	60	224		"
— 10	122	"	"	80	245		"
0	143	" (K)	"	100	266		"
+ 4	160	" + LiBr.2H ₂ O (B)	"	159	...		LiBr.H ₂ O + LiBr (B)

The more recent determinations of Hüttig and Reinscher, 1924, and of Hüttig and Steudemann, 1927, (made by the freezing-point method) do not agree with the above older results, especially for the di and tri hydrate. The following values were taken from an average curve constructed from the results of Hüttig and co-workers.

°	Gms. LiBr per 100 gms. sat. sol.	Solid Phase	°	Gms. LiBr per 100 gms. sat. sol.	Solid Phase
— 72	39.1	Ice + LiBr.5H ₂ O	25	63.0	LiBr.2H ₂ O
— 53	47.9	LiBr.5H ₂ O + LiBr.3H ₂ O	32	65.4(?)	" + LiBr.H ₂ O
— 30	51.0	LiBr.3H ₂ O	33	67.6(?)	" "
— 10	55.0	"	40	67.8	LiBr.H ₂ O
+ 4	59.2	" + LiBr.2H ₂ O	60	69.0	"
10	59.5	LiBr.2H ₂ O	80	71.0	"
20	61.6	"	100	72.7	"

SOLUBILITY OF LITHIUM BROMIDE IN AQUEOUS SOLUTIONS
OF HYDROBROMIC ACID AT 25°.

(Scott and Durham, 1930.)

Gms. per 100 gms. sat. solution		Solid Phase
HBr	LiBr	
0.0	60.41	LiBr.2H ₂ O
5.44	55.29	"
23.93	38.09	"
29.90	34.45	"

SOLUBILITY OF LITHIUM BROMIDE IN AQUEOUS SOLUTIONS OF
ETHYL ALCOHOL AT 25°.

(Simmons, Freiluth and Russell, 1936.)

Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase
C ₂ H ₅ OH	LiBr		C ₂ H ₅ OH	LiBr	
0.0	65.31	LiBr.2H ₂ O	43.28	47.63	LiBr.H ₂ O
4.88	62.08	"	47.57	46.70	"
10.23	59.06	"	46.53	46.63	" + LiBr
14.44	56.68	"	47.86	46.51	LiBr
20.09	55.24	"	51.66	44.13	"
26.59	52.98	"	55.24	42.45	"
33.05	52.07	" + LiBr.H ₂ O	58.78	41.22	"
35.43	50.79	LiBrH ₂ O			

SOLUBILITY OF LITHIUM BROMIDE IN ABSOLUTE ETHYL ALCOHOL.

(Bonnell and Jones, 1926.)

Gms. LiBr per 100 gms. C ₂ H ₅ OH.		Solid Phase.	Between 13°.2 and 23°.8 lithium bromide alcoholate is formed and different values are obtained depending upon the solid phase present.		
t°.			Gms. LiBr per 100 gms. C ₂ H ₅ OH when the Solid Phase is		
			t°.	LiBr.	LiBr.4 C ₂ H ₅ OH.
0.....	32.61	Li Br			
10.....	36.02	»			
25.....	72.10	»			
30.....	72.51	»			
40.....	73.03	»	13.2....	70.0	70.0
50.....	77.52	»	15.....	70.2	38.1 (68.7)
60.....	82.84	»	16.....	70.4	39.0 (67.5)
70.....	89.13	»	20.....	70.8	42.0 (60.6)
75.....	91.12	»	23.....	71.2	46.0 (53.0)
80.....	99.10	»	23.8.....	71.3	47.2

The results in parentheses were obtained by thermal analysis. The eutectic point for Li Br + Li Br.4 C₂H₅OH is at 13°.2. The congruent m. pt. of Li Br.4 C₂OH is 23°.8.

SOLUBILITY OF LITHIUM BROMIDE IN ABSOLUTE ACETONE.

(Bell, Rowlands, Bamford, Thomas and Jones, 1930.)

t°	Gms. Li Br per 100 gms. (CH ₃) ₂ CO	Solid Phase	t°	Gms. Li Br per 100 gms. (CH ₃) ₂ CO	Solid Phase
10	13.4	LiBr.2(CH ₃) ₂ CO	35.5	22.6	LiBr.2(CH ₃) ₂ CO + LiBr
20	18.2	"	37	23.7	LiBr
30	21.3	"	40	26.3	"
32	22.1	"	50	34.6	"
35	22.4	"	60	39.7	"

Determinations made by means of specific conductivity measurements by Lannung, 1932, gave 11.24 gms. LiBr per 100 gms. (CH₃)₂CO at 18° and 19.8 gms. at 37°.

100 gms. Glycol dissolve 60.0 gms. LiBr at 14.7°. (deConnick, 1905.)

Li LITHIUM LITHIUM BROMIDE

900

100 gms. sat. solution of lithium bromide in Benzaldehyde (C_6H_5CHO) contain 11.527 gms. LiBr at 25°. (Muller, Raschka and Wittemann,⁵ 1927.)

Fusion-point data are given for:

LiBr + LiCl (Botschmar, 1933.)
 " + LiF " "
 " + LiOH (Scarpa, 1915.)
 " + AgBr (Sandonnini and Scarpa, 1913.)
 " + KBr (Kellner, 1917.)
 " + MgBr₂ (Kellner, 1917; Ferrari and Calla, 1931.)
 " + NaBr₂ (Kellner, 1917.)
 " + SrBr₂ (Kellner, 1917.)

LITHIUM BROMATE $LiBrO_3 \cdot H_2O$.

SOLUBILITY OF LITHIUM BROMATE IN WATER.

(Simmons and Waldeck, 1931.)

BrO

t°	Gms. $LiBrO_3$ per 100 gms. sat. sol.	Solid Phase	t°	Gms. $LiBrO_3$ per 100 gms. sat. sol.	Solid Phase
5	61.6	$LiBrO_3 \cdot H_2O$	53	72.4	$LiBrO_3$
15	63.3	"	56	72.6	"
25	65.4	"	70.5	74.3	"
35	67.5	"	85	76.2	"
50	71.5	"	100	78.0	"

The transition temperature for $LiBrO_3 \cdot H_2O \rightarrow LiBrO_3$ is between 50.8° and 52°.

The previous determination of Mylius and Funk, 1897,⁶ of 60.4 gms. $LiBrO_3$ per 100 gms. sat. solution of density = 1.833, is apparently too low.

LITHIUM METHIONATE $Li_2[CH_2(SO_3)_2]$.

100 gms. H_2O sat. with Lithium Methionate contain 72.8 gms. $Li_2[CH_2(SO_3)_2]$ at 25°. (Baker and Terpstra, 1929; Baker, 1930.)

LITHIUM FORMATE $LiHCOO \cdot H_2O$.

SOLUBILITY OF LITHIUM FORMATE IN WATER.

(Groschuff, 1903.)

CH

t°	Gms. HCOOLi per 100 Gms. Solution.	Mols. HCOOLi per 100 Mols. H_2O .	Solid Phase.	t°	Gms. HCOOLi per 100 Gms. H_2O .	Mols. HCOOLi per 100 Mols. H_2O .	Solid Phase.
-20	21.14	9.28	$HCOOLi \cdot H_2O$	91	54.16	40.00	$HCOOLi \cdot H_2O$
0	24.42	11.18	"	98	57.05	45.00	$HCOOLi$
18	27.85	13.36	"	104	57.64	47.11	"
49.5	35.60	19.14	"	120	59.63	51.13	"
74	44.91	28.22	"				

Sp. gr. sat. sol. at 18° = 1.142.

FREEZING-POINTS OF AQUEOUS LITHIUM FORMATE SOLUTIONS.

(Silgwick and Gentle, 1922.)

FREEZING-POINTS OF MIXTURES OF LITHIUM FORMATE AND FORMIC ACID.

(Kendall and Adler, 1921.)

The previous results on this system by Groschuff, 1903 are considered to be largely in error.

t°	Gm. Mols. LiHCOO per 100 gm. mols. mixture	Solid Phase	t°	Gm. Mols. LiHCOO per 100 gm. mols. mixture	Solid Phase	t°	Gm. Mols. LiHCOO per 100 gm. mols. mixture	Solid Phase
8.4	0.0	HCOOH-14.6	18.19		HCOOH	90.5	25.91	LiHCOO
7.0	1.58	"	-17.1	19.56	"	97.9	26.38	"
5.2	3.47	"	-19.8	21.25	"	113.1	27.71	"
3.2	5.23	"	-21.7	22.24	"	131.2	29.87	"
1.1	7.09	"	-23.5	23.49	"	145.1	31.98	"
-1.3	8.93	"	-25.0	24.33	"	150.4	33.04	"
-3.5	10.75	"	-18.0	23.49	LiHCOO	159.1	35.01	"
-5.6	12.23	"	34.0	23.98	"	163.5	36.13	"
-8.2	13.99	"	80.0	25.31	"			

LITHIUM ACETATE $\text{CH}_3\text{COOLi} \cdot 2\text{H}_2\text{O}$.

SOLUBILITY OF LITHIUM ACETATE IN WATER.

(Sidgwick and Gentle, 1922.)

t°	Gms. CH_3COOLi per 100 gms. sat. sol.	Solid Phase	t°	Gms. CH_3COOLi per 100 gms. sat. sol.	Solid Phase
-1.54....	2.63	Ice	53.3....	52.23	$\text{CH}_3\text{COOLi} \cdot 2\text{H}_2\text{O}$
-2.98....	4.83	"	55.4....	56.60	"
-6.62....	9.53	"	57.3....	61.92	"
-16.12....	18.33	"	57.8(mf. pt.)	64.25	"
± 0.....	23.76	$\text{CH}_3\text{COOLi} \cdot 2\text{H}_2\text{O}$	57.0....	64.88	CH_3COOLi
+25.8....	31.28	"	102.8....	66.73	"
36.7....	38.25	"	157.5....	71.33	"
50.5....	49.55	"	286(mf. pt.)		"

FREEZING-POINTS OF MIXTURES OF LITHIUM ACETATE AND ACETIC ACID.

(Davidson and McAllister, 1930.)

t°	Gm. Mols. $\text{LiC}_2\text{H}_3\text{O}_2$ per 100 gm. mols. mixture	Solid Phase	t°	Gm. Mols. $\text{LiC}_2\text{H}_3\text{O}_2$ per 100 gm. mols. mixture	Solid Phase
16.50	0.0	$\text{HC}_2\text{H}_3\text{O}_2$	110.0	41.84*	1.1
14.85	3.56	"	112.0	45.74*	"
14.16	5.01	"	112.5	48.76*	"
13.15	6.86	"	112.5	50.06*	"
12.10	8.45	"	136.0	43.95	$\text{LiC}_2\text{H}_3\text{O}_2$
16.7	8.61	1.1	147.5	46.04	"
22.1	9.15	"	156.0	47.57	"
25.0	9.53	"	161.0	48.22	"
51.0	12.28	"	178.5	52.41	"
70.0	16.24	"	188.0	55.89	"
83.0	20.25	"	192.0	56.90	"
98.0	27.64	"	221.0	70.87	"
106.5	35.34	"	272.	100.00	"
109.0	39.83	"			

* Metastable; 1.1 = $\text{LiC}_2\text{H}_3\text{O}_2 \cdot \text{HC}_2\text{H}_3\text{O}_2$.

Previous determinations upon this system are given by Vasilev, 1909.

100 gms. methyl alcohol (CH_3OH) sat. with dehydrated lithium acetate dissolve 30.37 gms. $\text{LiC}_2\text{H}_3\text{O}_2$ at 15° and 32.47 gms. at 67.2° (b.pt.) (Henstock, 1934.)

Li LITHIUM

902

LITHIUM Phenyl ACETATE $\text{LiC}_6\text{H}_7\text{CO}_2$

Fusion-point data for mixtures of Lithium phenyl acetate ($\text{LiC}_6\text{H}_7\text{CO}_2$) and Phenyl acetic acid ($\text{HC}_6\text{H}_7\text{CO}_2$) and for Lithium phenyl acetate and Phenyl acetic anhydride, $(\text{C}_6\text{H}_7\text{CO})_2\text{O}$, are given by Bakunin and Vitale, 1935.

LITHIUM CITRATE $\text{C}_3\text{H}_4(\text{OH})(\text{COOLi})_3 \cdot 4\text{H}_2\text{O}$.

100 gms. H_2O dissolve 61.2 gms. Li citrate at 15° . $d_{15}^{\text{sat. sol.}} = 1.187$.
(Greenish and Smith, 1902.)

SOLUBILITY IN AQUEOUS ALCOHOL AT 25° . (Seidell, 1910.)

Wt. % $\text{C}_2\text{H}_5\text{OH}$ in Solvent.	$d_{25}^{\text{sat. Sol.}}$	Gms. $\text{C}_3\text{H}_4(\text{OH})(\text{COOLi})_3 \cdot 4\text{H}_2\text{O}$ per 100 Gms. Solvent.	Wt. % $\text{C}_2\text{H}_5\text{OH}$ in Solvent.	$d_{25}^{\text{sat. Sol.}}$	Gms. $\text{C}_3\text{H}_4(\text{OH})(\text{COOLi})_3 \cdot 4\text{H}_2\text{O}$ per 100 Gms. Solvent.
0	1.216	74.50	50	0.933	4.93
10	1.150	49.30	60	0.897	2.25
20	1.083	32.10	70	0.867	0.60
30	1.025	18.80	80	0.838	0.30
40	0.976	9.65	100	0.788	0.02

CH

LITHIUM TARTRATES.

SOLUBILITY IN WATER.

Salt.	Formula.	t°.	Gms. Salt per 100 Gms. Sat. Sol.	Authority.
Lithium Dihydroxytartrate	$\text{Li}_2\text{C}_4\text{H}_4\text{O}_6 \cdot \frac{1}{2}\text{H}_2\text{O}$	0	0.079	(Fenton, 1898.)
Lithium Sodium Racemic Tartrate	$\text{LiNaC}_4\text{H}_4\text{O}_6 \cdot 2\text{H}_2\text{O}$	20	19.97	(Schlossberg, 1900.)
" " Dextro "	" "	20	22.55	"
" Potassium Racemic "	$\text{LiKC}_4\text{H}_4\text{O}_6 \cdot \text{H}_2\text{O}$	20	35.19	"
" " Dextro "	" "	20	37.82	"

THE SYSTEM LITHIUM AMMONIUM d-TARTRATE, LITHIUM AMMONIUM l-TARTRATE AND WATER.

(Campbell and Slotin, 1933.)

The saturated solutions and the solid phases were analyzed polarimetrically using as a scale the rotations of solutions of pure Lithium Ammonium d Tartrate of different concentrations, determined for the sodium D line at 30° . The isotherm at 0° was determined and the invariant points only at 30° and 60° .

t°	Gms. per 100 gms. H_2O $\text{d-LiNH}_4\text{C}_4\text{H}_4\text{O}_6$	Gms. per 100 gms. H_2O $\text{l-LiNH}_4\text{C}_4\text{H}_4\text{O}_6$	Solid Phase
0	0.0	2.806	Racemate form ($= \text{Li}_2(\text{NH}_4)_2\text{C}_4\text{H}_4\text{O}_6 \cdot \text{H}_2\text{O}$)
"	6.531	2.363	"
"	12.241	1.860	"
"	17.690	1.64	"
"	23.251	1.462	" + d form
"	24.810	0.98	d form
"	28.519	0	"
30	0.0	6.542	Racemate form

SOLUBILITY OF LITHIUM d-TARTRATE IN WATER.
(Campbell and Slotin, 1933.)

t°	Gms. $\text{Li}_2\text{C}_4\text{O}_6$ per 100 gms. H_2O	Solid Phase	t°	Gms. $\text{Li}_2\text{C}_4\text{O}_6$ per 100 gms. H_2O	Solid Phase
0	42.106	$\text{Li}_2\text{C}_4\text{H}_4\text{O}_6 \cdot 2\text{H}_2\text{O}$	25	26.711	$\text{LiC}_4\text{H}_4\text{O}_6$
8.0	33.451	"	30	26.663	"
10.55	31.495	"	45	27.510	"
20.0	27.052	"	60	29.532	"
21.67 tr.pt.	—	" + $\text{LiC}_4\text{H}_4\text{O}_6$			

EQUILIBRIUM IN THE SYSTEM LITHIUM d-TARTRATE, AMMONIUM
d-TARTRATE AND WATER.
(Campbell and Slotin, 1933.)

Gms. per 100 gms. H ₂ O		Solid Phase	Gms. per 100 gms. H ₂ O		Solid Phase
(NH ₄) ₂ C ₄ O ₆	Li ₂ C ₄ O ₆		(NH ₄) ₂ C ₄ H ₄ O ₆	Li ₂ C ₄ H ₄ O ₆	
Results at 0°			Results at 30° (con.)		
0.0	42.106	Li ₂ C ₄ H ₄ O ₆ · 2H ₂ O	24.662	14.732	DS
2.510	36.857	"	29.651	11.603	"
3.473	32.561	"	39.671	8.182	"
6.013	30.160	" + DS	63.600	6.916	"
8.022	22.125	DS	66.205	6.771	" + (NH ₄) ₂ C ₄ H ₄ O ₆
14.491	14.092	"	66.310	3.326	(NH ₄) ₂ C ₄ H ₄ O ₆
23.081	8.846	"	63.813	0.0	"
36.610	7.011	"	Results at 60°		
45.930	6.026	" + (NH ₄) ₂ C ₄ H ₄ O ₆			
45.125	3.952	(NH ₄) ₂ C ₄ O ₆	0.0	29.552	Li ₂ C ₄ O ₆
44.251	1.973	"	5.807	30.051	"
43.916	0.0	"	11.003	31.452	"
Results at 30°			16.349	34.242	"
			23.121	37.981	" + DS
			24.431	27.609	DS
			41.083	16.151	"
0.0	26.661	Li ₂ C ₄ O ₆	63.011	13.103	"
3.076	27.143	"	98.392	10.244	" + (NH ₄) ₂ C ₄ H ₄ O ₆
7.703	29.181	"	92.832	6.650	(NH ₄) ₂ C ₄ H ₄ O ₆
9.350	30.661	"	90.247	3.631	"
11.980	32.731	" + DS	87.171	0.0	"
14.672	26.071	DS			
16.744	22.603	"			

DS = $\text{Li}_2\text{C}_4\text{H}_4\text{O}_6 \cdot (\text{NH}_4)_2\text{C}_4\text{H}_4\text{O}_6$.

LITHIUM BENZOATE $\text{C}_6\text{H}_5\text{COOLi} \cdot \text{H}_2\text{O}$.

SOLUBILITY OF LITHIUM BENZOATE IN WATER.
(Sidgwick and Ewbank, 1922.)

t°.	Gms. $\text{C}_6\text{H}_5\text{COOLi}$ per 100 gms. sat. sol.	Solid Phase.	t°.	Gms. $\text{C}_6\text{H}_5\text{COOLi}$ per 100 gms. sat. sol.	Solid Phase
— 1.69....	7.22	Ice	34.5....	33.20	$\text{C}_6\text{H}_5\text{COOLi} \cdot \text{H}_2\text{O}$
— 3.94....	13.69	"	84.5....	34.61	$\text{C}_6\text{H}_5\text{COOLi}$
— 6.49....	19.85	"	111.0....	36.51	"
0.....	27.97	$\text{C}_6\text{H}_5\text{COOLi} \cdot \text{H}_2\text{O}$	162.4....	45.14	"
+13.5....	29.80	"	176.0....	49.12	"
28.5....	32.12	"			

100 gms. Methyl Alcohol (CH_3OH) saturated with dehydrated lithium benzoate contain 20.52 gms. $\text{LiC}_6\text{H}_5\text{COO}$ at 15° and 19.71 gms. at 67° (b.pt.). (Henstock, 1934.)

LITHIUM BENZOATE C_6H_5COOLi .

SOLUBILITY IN AQUEOUS ALCOHOL SOLUTIONS AT 25°.

(Seidell, 1910.)

Per cent C_2H_5OH in Solvent.	d_{25} of Sat. Sol.	Gms. C_6H_5COOLi per 100 Gms. Sat. Sol.	Per cent C_2H_5OH in Solvent.	d_{25} of Sat. Sol.	Gms. C_6H_5COOLi per 100 Gms. Sat. Sol.
0	1.103	27.64	60	0.970	19.80
10	1.088	28.60	70	0.932	15.40
20	1.072	28.50	80	0.890	10.70
30	1.052	27.80	90	0.847	6.40
40	1.030	26.20	95	0.823	4.50
50	1.003	23.60	100	0.799	2.60

100 gms. H_2O dissolve about 40 gms. C_6H_5COOLi at the b. pt.

(U.S.P.)

100 gms. alcohol dissolve about 10 gms. C_6H_5COOLi at the b. pt.

"

LITHIUM o Hydroxy BENZOATE (Lithium Salicylate) $C_6H_4(OH)COOLi.H_2O$.

SOLUBILITY OF LITHIUM ORTHO HYDROXYBENZOATE IN WATER.

(Sidgwick and Ewbank, 1922.)

t° .	Gms. $o C_6H_4(OH)COOLi$ per 100 gms. sat. sol.	Solid Phase.	t° .	Gms. $o C_6H_4(OH)COOLi$ per 100 gms. sat. sol.	Solid Phase.
— 2.26...	10.17	Ice	28.5...	56.50	$o C_6H_4(OH)COOLi.H_2O$
— 5.56...	20.62	"	32.0...	57.50	"
— 12.82...	35.83	"	38.5...	59.67	"
— 8.5...	45.20	$o C_6H_4(OH)COOLi.H_2O$	52.0...	64.18	" (unstable)
— 1.0...	49.04	"	60.0...	66.56	"
+ 9.0...	52.45	$o C_6H_4(OH)COOLi.H_2O$	73.0...	66.56	$o C_6H_4(OH)COOLi$
3.5...	52.96	$o C_6H_4(OH)COOLi.H_2O$ (unstable)	113.0...	71.46	"
10.0...	59.96	$o C_6H_4(OH)COOLi.H_2O$	138.0...	75.77	"

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SOLUBILITY OF LITHIUM META AND PARA HYDROXYBENZOATES IN WATER.

(Sidgwick and Ewbank, 1922.)

Results for Meta Hydroxybenzoate.			Results for Para Hydroxybenzoate.		
t° .	Gms. $m C_6H_4(OH)COOLi$ per 100 gms. sat. sol.	Solid Phase.	t° .	Gms. $p C_6H_4(OH)COOLi$ per 100 gms. sat. sol.	Solid Phase.
— 4.41...	16.02	Ice	— 0.98...	5.04	Ice
— 10.78...	29.58	"	2.37...	9.81	"
— 17.67...	39.97	"	5.23...	17.88	"
+ 10.0...	52.53	$m C_6H_4(OH)COOLi$	9.28...	25.96	"
74.5...	55.04	"	12.6...	31.54	" (unstable)
104.0...	58.47	"	+ 12.5...	30.84	$p C_6H_4(OH)COOLi$
122.0...	61.86	"	0...	30.92	"
			85.0...	31.96	"
			113.0...	35.00	"

LITHIUM SALICYLATE $C_6H_4(OH)COOLi.H_2O$.

SOLUBILITY IN AQUEOUS ALCOHOL SOLUTIONS AT 25°.

(Seidell, 1909, 1910.)

Gms. C_2H_5OH per 100 Gms. Solvent.	d_{25} of Sat. Sol.	Gms. $C_6H_4(OH)COOH.H_2O$ per 100 Gms. Sat. Sol.	Gms. C_2H_5OH per 100 Gms. Solvent.	d_{25} of Sat. Sol.	Gms. $C_6H_4(OH)COOH.H_2O$ per 100 Gms. Sat. Sol.
0	1.209	56	60	1.104	51.1
10	1.195	55.9	70	1.083	49.5
20	1.180	55.4	80	1.056	47.5
30	1.163	54.7	90	1.026	45.8
40	1.144	53.7	92.3	1.020	45.6
50	1.124	52.5	100	1.027	48.2

100 gms. propyl alcohol dissolve 18.7 gms. Li salicylate (temp.?). (Schlamp, 1892)

LITHIUM HIPPURATE $C_6H_5CO.NHCH_2COOLi$.100 gms. H_2O dissolve about 40 gms. of the salt at $15-20^\circ$.**LITHIUM PHTHALATE** $2Li_2C_8H_4O_4 \cdot 3H_2O$.

(Squire and Caines, 1905.)

EQUILIBRIUM IN THE SYSTEM LITHIUM PHTHALATE, PHTHALIC ACID AND WATER.

(Smith, Sturm and Ely, 1935.)

Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase
$H_2C_8H_4O_4$	$Li_2C_8H_4O_4$		$H_2C_8H_4O_4$	$Li_2C_8H_4O_4$	

Results at 0°

0.0	45.37	$2Li_2C_8H_4O_4 \cdot 3H_2O$	14.01	25.56	$LiHC_8H_4O_4 \cdot 2H_2O$
1.27	45.41	"	16.34	24.25	" + $H_2C_8H_4O_4$
2.81	45.75	" + $LiHC_8H_4O_4 \cdot 2H_2O$	13.32	19.39	$H_2C_8H_4O_4$
2.84	40.55	$LiHC_8H_4O_4 \cdot 2H_2O$	10.56	14.56	"
3.46	36.25	"	6.97	8.87	"
4.15	32.40	"	3.34	3.22	"
7.15	26.09	"	0.68	0.0	"
9.61	22.45	" + $H_2C_8H_4O_4$			
8.67	20.39	$H_2C_8H_4O_4$			

Results at 50°

7.45	16.55	"	0.0	46.08	$2Li_2C_8H_4O_4 \cdot 3H_2O$
5.58	11.06	"	3.73	46.01	"
3.92	5.83	"	6.40	46.00	"
1.97	2.28	"	9.97	46.01	" + $LiHC_8H_4O_4 \cdot 2H_2O$
0.30	0.0	"	12.42	39.32	$LiHC_8H_4O_4 \cdot 2H_2O$

Results at 25°

0.0	45.20	$2Li_2C_8H_4O_4 \cdot 3H_2O$	15.07	34.77	"
2.38	45.17	"	18.92	30.05	"
3.60	45.15	"	21.78	28.29	"
5.20	45.19	" + $LiHC_8H_4O_4 \cdot 2H_2O$	24.00	26.69	" + $H_2C_8H_4O_4$
6.51	38.13	$LiHC_8H_4O_4 \cdot 2H_2O$	20.21	21.36	$H_2C_8H_4O_4$
7.79	34.07	"	15.29	15.28	"
9.08	32.36	"	11.48	10.80	"
11.39	28.23	"	6.81	5.30	"
			4.75	3.28	"
			1.75	0.0	"

EQUILIBRIUM IN THE SYSTEM LITHIUM PHTHALATE, MAGNESIUM PHTHALATE AND WATER.

(Smith and Ely, 1936.)

Gms. per 100	gms. sat. sol.	Solid Phase	Gms. per 100	gms. sat. sol.	Solid Phase
$MgC_8H_4O_4$	$Li_2C_8H_4O_4$		$MgC_8H_4O_4$	$Li_2C_8H_4O_4$	

Results at 25°			Results at 25° (con.)		
0.0	45.24	$2Li_2C_8H_4O_4 \cdot 3H_2O$	31.09	4.55	$2MgC_8H_4O_4 \cdot 11H_2O$
7.52	41.12	"	34.14	0.0	"
12.98	36.72	"			
16.39	34.50	"	Results at 50°		
19.27	33.05	"			
19.97	32.50	" + $2MgC_8H_4O_4 \cdot 11H_2O$	0.0	46.01	$2Li_2C_8H_4O_4 \cdot 3H_2O$
20.43	29.53	$2MgC_8H_4O_4 \cdot 11H_2O$	6.97	41.76	"
20.96	26.88	"	18.32	35.22	"
22.40	21.78	"	26.06	31.05	"
23.06	19.63	"	34.75	17.49	$2MgC_8H_4O_4 \cdot 11H_2O$
25.31	14.86	"	36.10	11.74	"
			40.31	3.18	"
			42.28	0.0	"

Li LITHIUM

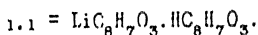
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LITHIUM Racemic and Laevo MANDELATES $\text{LiC}_8\text{H}_7\text{O}_3$.

EQUILIBRIUM IN THE SYSTEM LITHIUM (r) RACEMIC MANDELATE, RACEMIC MANDELIC ACID AND WATER AT 25° .

(Ross and Morrison, 1933.)

Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase
$\text{HC}_8\text{H}_7\text{O}_3$	$\text{LiC}_8\text{H}_7\text{O}_3$		$\text{HC}_8\text{H}_7\text{O}_3$	$\text{LiC}_8\text{H}_7\text{O}_3$	
0.0	4.9	$\text{LiC}_8\text{H}_7\text{O}_3$	13.7	3.3	1.1
0.9	4.7	"	14.6	3.2	"
4.0	4.7	"	15.3	3.2	"
4.7	5.0	" + 1.1	16.2	3.1	"
6.6	4.2	1.1	18.2	3.1	"
8.3	3.9	"	19.0	3.0	"
9.9	3.6	"	20.1	3.0	" + $\text{HC}_8\text{H}_7\text{O}_3$
11.1	3.6	"	18.8	1.6	$\text{HC}_8\text{H}_7\text{O}_3$
13.0	3.3	"	16.9	0.0	"



EQUILIBRIUM IN THE SYSTEM LITHIUM (-) LAEVO MANDELATE, LAEVO MANDELIC ACID AND WATER AT 25° .

(Ross, Morrison and Johnstone, 1937.)

CH

Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase
$(-)\text{HC}_8\text{H}_7\text{O}_3$	$(-)\text{LiC}_8\text{H}_7\text{O}_3$		$(-)\text{HC}_8\text{H}_7\text{O}_3$	$(-)\text{LiC}_8\text{H}_7\text{O}_3$	
0.0	8.6	$(-)\text{LiC}_8\text{H}_7\text{O}_3$	10.6	3.5	1.1
1.0	8.5	"	11.9	3.4	"
1.3	8.6	"	10.3	3.4	$(-)\text{HC}_8\text{H}_7\text{O}_3$
2.6	5.6	1.1	10.2	2.6	"
5.6	4.0	"	10.0	1.7	"
6.9	4.0	"	9.9	0.8	"
9.2	3.7	"	10.1	0.0	"



DILITHIUM d CAMPHORATE $\text{C}_{10}\text{H}_{14}\text{O}_4\text{Li}_2$.

SOLUBILITY IN AQUEOUS SOLUTIONS OF CAMPHORIC ACID AT 13.5° - 16° AND VICE VERSA.

(Jungfleisch and Landrieu, 1914.)

Gms. per 100 Gms. Sat. Sol.		Solid Phase.	
$\text{C}_6\text{H}_8(\text{COOH})_2$	$\text{C}_{10}\text{H}_{14}\text{O}_4\text{Li}_2$		
0.621	0	Camphoric Acid	$\text{C}_6\text{H}_8(\text{COOH})_2$
2.02	3.77	"	"
3.25	10.63	Monolithium Tetracamphorate	$\text{C}_{10}\text{H}_{14}\text{O}_4\text{Li} \cdot 3\text{C}_{10}\text{H}_{16}\text{O}_4$
3.51	12.61	"	"
3.99	20.56	" Dicumphorate	$\text{C}_{10}\text{H}_{14}\text{O}_4\text{Li} \cdot \text{C}_{10}\text{H}_{16}\text{O}_4$
3.43	24.69	"	"
2.87	37.16	" Camphorate	$\text{C}_{10}\text{H}_{14}\text{O}_4\text{Li}$
0	40.80	Dilithium Camphorate	$\text{C}_{10}\text{H}_{14}\text{O}_4\text{Li}_2$

The mixtures were kept in a cellar at nearly constant temperature and shaken from time to time until equilibrium was reached. Additional results at 17° - 23° are also given.

LITHIUM LAURATE, MYRISTATE, PALMITATE and STEARATE.

SOLUBILITY OF EACH OF THESE SALTS, DETERMINED SEPARATELY, IN
SEVERAL SOLVENTS.

(Jacobson and Holmes, 1916.)

Li laurate = $C_{11}H_{23}COOLi$. Li myristate = $C_{13}H_{27}COOLi$, Li palmitate = $CH_3(CH_2)_{14}COOLi$ and Li stearate = $CH_3(CH_2)_{16}COOLi$.

Excess of salt shaken with solvent for 2 hrs. in all cases. The sat. sol. was analyzed by evaporating to dryness and weighing residue.

Solvent.	t°.	Gms. of Each Salt (determined separately) per 100 Gms. Solvent.			
		Li Laurate.	Li Myristate.	Li Palmitate.	Li Stearate.
Abs. Ethyl Alcohol	20	0.403	0.194	0.006	0.072
" "	25.4	0.447	0.224	0.118	0.080
" "	35	0.546	0.278	0.142	0.106
" "	50	0.782	0.435	0.248	0.200
" "	65	1.149	0.669	0.391	0.333
Methyl Alcohol	15.2	3.159	1.346	0.616	0.349
" "	25	3.773	1.680	0.771	0.439
" "	34.6	4.597	2.193	1.086	0.658
" "	50	6.088	3.281	1.652	1.057
Water	16.3	0.154	0.027	0.010	0.009
" "	25	0.187	0.036	0.015	0.010
" "	35	0.207	0.042	0.015	0.010
" "	50	0.280	0.062	...	...
Ether	15.8	0.011	0.013	0.007	0.011
" "	25	0.006	0.004	0.007	0.011
Amyl Alcohol	16	0.073	0.020	0.010	0.011
" "	25.7	0.111	0.046	0.032	0.028
" "	35	0.126	0.062	0.033	0.031
" "	40.2	0.203	0.109	0.069	0.060
Chloroform	15.2	0.006	0.004	0.004	0.004
Amyl Acetate	14.5	0.068	0.037	0.038	0.034
" "	25	0.064	0.034	0.024	0.029
" "	35	0.061	0.044	0.037	0.031
" "	50	0.061	0.045	0.036	0.044
Methyl Acetate	24.5	0.026	0.013	0.015	0.012
Acetone	15	0.300	0.413	0.434	0.571
" "	25	0.376	0.447	0.508	0.706
" "	35	0.430	0.502	0.537	0.663

The above lithium salts were prepared by adding the calculated amount of lithium acetate to the alcoholic solutions of the respective fatty acids. The resulting precipitates were dissolved in boiling alcohol and the solutions allowed to stand over night in a cool place. The salts so obtained were washed and dried.

LITHIUM LAURATE, MYRISTATE, etc.

SOLUBILITY IN WATER AND IN ALCOHOL OF $d = 0.797$, AT 18° AND AT 25° .
(Partheil and Ferie, 1903.)

Salt.	Formula.	Gms. Salt per 100 cc. Sat. Solution in:			
		Water at		Alcohol at	
		18° .	25° .	18° .	25° .
Stearate	$C_{17}H_{35}COOLi$	0.010	0.011	0.041	0.0532
Palmitate	$C_{15}H_{31}COOLi$	0.011	0.018	0.0796	0.0956
Myristate	$C_{13}H_{27}COOLi$	0.0232	0.0234	0.184	0.2100
Laurate	$C_{11}H_{23}COOLi$	0.158	0.1726	0.418	0.4424
Oleate	$C_{17}H_{33}COOLi$	0.0674	0.1320	0.9084	1.010

LITHIUM Platino **CYANIDE** $Li_2Pt(CN)_4 \cdot 2H_2O$.

SOLUBILITY OF LITHIUM PLATINOCYANIDE IN WATER.

(Terry and Jolly, 1923.)

CN	t° .	Gms. $Li_2Pt(CN)_4$ per 100 gms. H_2O .	t° .	Gms. $Li_2Pt(CN)_4$ per 100 gms. H_2O .	t° .	Gms. $Li_2Pt(CN)_4$ per 100 gms. H_2O .	t° .	Gms. $Li_2Pt(CN)_4$ per 100 gms. H_2O .
	0.0...	105.0	30.1...	152.3	40.0...	160.3	50.1...	175.0
	16.3...	139.5	30.5...	156.1	42.5...	160.5	53.0...	182.0
	22.2...	141.5	31.5...	152.0	42.7...	181.2	55.2...	173.8
	23.0...	153.5	32.2...	152.4	43.1...	188.2	60.7...	178.0
	24.1...	144.8	34.9...	166.6	43.2...	162.3	64.8...	185.7
	25.0...	144.7	35.0...	154.6	45.0...	196.0	66.0...	205.2
	25.7...	153.0	35.8...	155.6	45.7...	165.0	71.0...	204.0
	25.8...	146.3	37.3...	173.0	46.6...	176.1	72 (tr. pt.)	
	26.5...	147.5	38.0...	155.3	47.2...	186.0	78.2...	213.7
	26.8...	151.2	38.8...	158.2	48.0...	173.0	88.2...	229.0
	28.5...	148.5	39.2...	154.4	49.0 (tr. pt.)		89.8...	238.7
	29.5 (tr. pt.)		39.5 (tr. pt.)		49.2...	173.1		

EQUILIBRIUM IN THE SYSTEM LITHIUM PLATINOCYANIDE,

POTASSIUM PLATINOCYANIDE AND WATER AT 24.0° .

(Terry and Jolly, 1923.)

CNS	Gms. per 100 gms. sat. sol.		Solid Phase.	Gms. per 100 gms. sat. sol.		Solid Phase.
	$Li_2Pt(CN)_4$.	$K_2Pt(CN)_6$.		$Li_2Pt(CN)_4$.	$K_2Pt(CN)_6$.	
	59.2	0.0	$Li_2Pt(CN)_4 \cdot 2H_2O$	29.3	18.7	$LiKPt(CN)_4 \cdot 2H_2O$
	54.2	1.7	$LiKPt(CN)_4 \cdot 2H_2O$	28.7	18.2	$K_2Pt(CN)_6 \cdot 3H_2O$
	54.1	2.2	"	27.3	16.1	"
	52.1	2.7	"	23.0	19.8	"
	45.9	4.4	"	22.0	19.4	"
	38.9	9.2	"	19.3	20.2	"
	36.5	11.2	"	10.2	23.6	"
	34.0	12.3	"	6.1	26.5	"
	30.5	13.9	"	4.6	26.9	"
	28.5	16.1	"	0.0	28.6	"

LITHIUM Thio **CYANATE** $LiSCN \cdot 2H_2O$

SOLUBILITY OF LITHIUM THIOCYANATE IN WATER.

(Iwase, 1970.)

t°	Gms. $LiSCN$ per 100 gms. sat. sol.	Solid Phase	t°	Gms. $LiSCN$ per 100 gms. sat. sol.	Solid Phase
20	53.2	$LiSCN \cdot 2H_2O$	34	—	$LiSCN \cdot 2H_2O + LiSCN$
25	54.5	"	35	58.8	$LiSCN$
30	56.7	"	40	60.4	"

LITHIUM CARBONATE Li_2CO_3 .

SOLUBILITY IN WATER.

(Bevade, 1885; Flückiger, 1887; Draper, 1887.)

An average curve was constructed from the available results and the following table read from it.

t.°.	Gms. Li_2CO_3 per 100 Gms.		t.°.	Gms. Li_2CO_3 per 100 Gms.	
	Water.	Solution.		Water.	Solution.
0	1.54	1.52	40	1.17	1.16
10	1.43	1.41	50	1.08	1.07
20	1.33	1.31	60	1.01	1.00
25	1.29	1.28	80	0.85	0.84
30	1.25	1.24	100	0.72	0.71

Density of saturated solution at $0^\circ = 1.017$; at $15^\circ = 1.014$.

More recent results at 0° agreeing with the above are given by Rosenheim and Reglin, 1921; and at 0° and 100° , by Kraus and Burgess, 1927.

Determinations of the equilibrium in aqueous solutions of lithium carbonate and bicarbonate in relation to the partial pressure of the carbon dioxide in the gas phase in contact with the solution are given by Walker, Bray and Johnston, 1927.

SOLUBILITY OF LITHIUM CARBONATE IN WATER UNDER HIGH PRESSURES OF CARBON DIOXIDE.

(Haehnle, 1937.)

A platinum lined autoclave was used and the mixtures shaken 1 hour and allowed to stand 1/2 hour before removing a sample for analysis. Lithium carbonate goes into solution in water in presence of $(\text{CO}_2)_g$ as bicarbonate. Such aqueous bicarbonate solutions are stable above -12° only under a CO_2 pressure of more than 1 atmosphere. The results are presented both in terms of gms. of Li_2CO_3 (shown in parentheses in the following table) and of LiHCO_3 per 100 gms. sat. solution.

Pressure of CO_2 in Atmospheres	Gms. LiHCO_3 per 100 gms. saturated solution at:			
	-12°	-10°	-5°	
1	22.71 (12.36)	21.25 (11.36)	16.12 (8.77)	
3	22.71 (12.36)	22.43 (12.20)	—	—
5	—	22.43 (12.20)	21.36 (11.62)	
8	—	—	21.36 (11.62)	
10	—	—	—	
13	—	—	—	
16	—	—	—	
20	—	—	—	
30	—	—	—	
34	—	—	—	
50	—	—	—	
Pressure of CO_2 in Atmospheres	Gms. LiHCO_3 per 100 gms. saturated solution at:			
	0°	$+18^\circ$	$+40^\circ$	$+60^\circ$
1	14.13 (7.69)	10.56 (5.75)	8.55 (4.65)	7.33 (3.99)
3	—	—	—	—
5	16.96 (9.23)	12.52 (6.82)	8.62 (4.69)	—
8	19.91 (10.83)	—	—	—
10	19.91 (10.83)	14.90 (8.11)	8.68 (4.72)	—
13	—	16.19 (8.81)	—	—
16	—	17.39 (9.41)	—	—
20	—	17.29 (9.41)	11.48 (6.25)	7.53 (4.10)
30	—	—	12.23 (6.66)	—
34	—	—	12.23 (6.65)	—
50	—	—	—	9.61 (5.23)

100 gms. H_2O dissolve 5.501 gms. LiHCO_3 at 13° . (Bevade, 1884.)

SOLUBILITY OF LITHIUM CARBONATE IN AQUEOUS SOLUTIONS OF
ALKALI SALTS AT 25°.

(Geffcken — Z. anorg. Chem. 43, 197, '05.)

The original results were calculated to gram quantities and plotted on cross-section paper. The figures in the following table were read from the curves.

Gms. Salt per Liter.	Grams Li_2CO_3 per Liter in Aqueous Solutions of:							
	KClO_3 .	KNO_3 .	KCl .	NaCl .	K_2SO_4 .	Na_2SO_4 .	NH_4Cl .	$(\text{NH}_4)_2\text{SO}_4$.
0	12.63	12.63	12.63	12.63	12.63	12.63	12.63	12.63
10	12.95	13.05	13.10	13.4	13.9	14.0	16.0	20.7
20	13.10	13.3	13.5	13.9	14.7	15.0	19.2	25.0
30	13.25	13.6	13.8	14.3	15.4	16.0	21.5	28.2
40	13.40	13.8	14.0	14.6	16.0	16.6	23.3	30.8
60	...	13.8	14.2	14.5	16.9	17.8	26.0	35.2
80	...	13.6	14.0	14.4	17.7	18.6	27.6	38.5
100	...	13.5	13.9	14.2	18.2	19.4	28.4	41.0
120	...	13.3	13.7	14.0	...	19.9	28.7	42.6
140	...	13.0	13.3	...	...	20.4	28.8	43.5
170	...	12.6	...	...	...	...	28.9	...
200	...	12.2	...	...	...	...	29.0	...

CO 100 gms. aq. alcohol of 0.941 Sp. Gr. dissolve 0.056 gm. Li_2CO_3 at 15.5°.

One liter sat. sol. in water contains 0.1722 gm. mols. = 12.73 gms. Li_2CO_3 at 25°.

(Agono and Valla, 1911.)

SOLUBILITY OF LITHIUM CARBONATE IN AQUEOUS SOLUTIONS OF ORGANIC COM-
POUNDS AT 25°.

(Rothmund, 1908, 1910; see also Traube, 1909.)

The solubility in H_2O = 0.1687 mols. Li_2CO_3 per liter = 12.47 gms. at 25°.

Aqueous Solution of:	Gm. Mols. Li_2CO_3 per Liter in Aq. Solution of:			
	0.125 Normality.	0.25 Normality.	0.5 Normality.	1 Normality.
Methyl Alcohol	...	0.1604	0.1529	0.1394
Ethyl Alcohol	0.1614	0.1555	0.1417	0.1203
Propyl Alcohol	0.1604	0.1524	0.1380	0.1097
Amyl Alcohol (tertiary)	0.1564	0.1442	0.1224	0.0899
Acetone	0.1600	0.1515	0.1366	0.1104
Ether	0.1580	0.1476	0.1300	...
Formaldehyde	0.1668	0.1653	0.1606	0.1531
Glycol	0.1660	0.1629	0.1505	0.1472
Glycerol	0.1670	0.1647	0.1613	0.1532
Mannite	0.1705	0.1737	0.1778	...
Grape Sugar	0.1702	0.1728	0.1752	0.1778
Cane Sugar	0.1693	0.1689	0.1661	0.1557
Urea	0.1686	0.1673	0.1643	0.1605
Thiourea	0.1667	0.1643	0.1600	0.1523
Dimethylpyrone	0.1562	0.1460	0.1280	0.0992
Ammonia	0.1653	0.1630	0.1577	0.1466
Diethylamine	0.1589	0.1481	0.1283	0.0937
Pyridine	0.1592	0.1503	0.1347	0.1091
Urethan	0.1604	0.1525	0.1377	0.1113
Acetamide	...	0.1614	0.1520	0.1358
Acetonitrile	0.1618	0.1556	0.1429	0.1178
Mercuricyanide	0.1697	0.1704	...	...

Freezing-point data for mixtures of $\text{Li}_2\text{CO}_3 + \text{Li}_2\text{SO}_4$

(Amadori, 1912.)

SOLUBILITY OF LITHIUM CARBONATE IN AQUEOUS SOLUTIONS
OF ACETONE AT 17.6°.
(Hartley, 1931.)

Mols. $(\text{CH}_3)_2\text{CO}$ per 1.0 Mol. $(\text{CH}_3)_2\text{CO} + \text{H}_2\text{O}$	Mols. Li_2CO_3 per 1.0 Mol. $\text{Li}_2\text{CO}_3 + (\text{CH}_3)_2\text{CO} + \text{H}_2\text{O}$
0.0	0.00331
0.0326	0.00211
0.0668	0.00105

SOLUBILITY OF LITHIUM CARBONATE IN AQUEOUS SOLUTIONS
OF SEVERAL ORGANIC COMPOUNDS.
(Weber, 1929.)

The solubility in water alone is 0.1691 gm. mols. Li_2CO_3 per liter.

Aqueous Solution of:	Gm. Mols. Li_2CO_3 per liter in Aq. Solution of:					
	0.005 Normality	0.0208 Normality	0.0417 Normality	0.0835 Normality	0.165 Normality	0.33 Normality
Paraldehyde	—	—	—	0.1629	0.1573	0.2167
Iso amyl alcohol	—	—	—	0.1621	0.1559	—
Hexyl alcohol	—	0.1666	0.1640	—	—	—
Octyl alcohol	0.1683	—	—	—	—	—

Fusion-point data for mixtures of $\text{Li}_2\text{CO}_3 + \text{Na}_2\text{CO}_3$ are given by Skaliks, 1928.)

LITHIUM OXALATE $\text{Li}_2\text{C}_2\text{O}_4$.

SOLUBILITY OF MIXTURES OF LITHIUM OXALATE AND OXALIC ACID IN
WATER AT 25°. (Foote and Andrew, 1905.)

Mixtures of the two substances were dissolved in water, and the solutions cooled in a thermostat to 25°.

Gms. per 100 Gms. Solution.		Mols. per 100 Mols. H_2O .		Solid Phase.
$\text{H}_2\text{C}_2\text{O}_4$.	$\text{Li}_2\text{C}_2\text{O}_4$.	$\text{H}_2\text{C}_2\text{O}_4$.	$\text{Li}_2\text{C}_2\text{O}_4$.	
10.20	...	2.274	...	$\text{H}_2\text{C}_2\text{O}_4 \cdot 2\text{H}_2\text{O}$
10.66	2.06 }	2.457	0.622	$\text{H}_2\text{C}_2\text{O}_4 \cdot \text{H}_2\text{O}$ and $\text{HLiC}_2\text{O}_4 \cdot \text{H}_2\text{O}$
10.55	3.11 }			
8.08	3.18	1.823	0.633 }	Double Salt $\text{HLiC}_2\text{O}_4 \cdot 4\text{H}_2\text{O}$ $= 39.2\text{H}_2\text{C}_2\text{O}_4$ and $44.7\text{Li}_2\text{C}_2\text{O}_4$
2.60	5.03	0.563	0.962 }	
2.16	6.54 }	0.469	1.273	$\text{HLiC}_2\text{O}_4 \cdot \text{H}_2\text{O}$ and $\text{Li}_2\text{C}_2\text{O}_4$
2.12	1.61 }			
	5.87	...	1.901	$\text{Li}_2\text{C}_2\text{O}_4$

100 gms. aqueous solution, simultaneously saturated with lithium oxalate and ammonium oxalate at 25°, contain 5.75 gms. $\text{Li}_2\text{C}_2\text{O}_4$ + 4.8 gms. $(\text{NH}_4)_2\text{C}_2\text{O}_4$.
(Foote and Andrew, 1905.)

LITHIUM OXALATE $\text{Li}_2\text{C}_2\text{O}_4$.

EQUILIBRIUM IN THE SYSTEM LITHIUM OXALATE, ZIRCONIUM OXALATE AND WATER AT 19°.

(Boulanger, 1936a.)

The solid phases were of uncertain composition since the zirconyl oxalate apparently hydrolyzed, yielding mixtures composed of the oxalates, oxalic acid and water.

COO	Gms. per 100 gms. sat. solution		Gms. per 100 gms. sat. sol.		Gms. per 100 gms. sat. sol.	
	$\text{Li}_2(\text{COO})_2$	$\text{ZrO}(\text{COO})_2$	$\text{Li}_2(\text{COO})_2$	$\text{ZrO}(\text{COO})_2$	$\text{Li}_2(\text{COO})_2$	$\text{ZrO}(\text{COO})_2$
	6.06	0.0	6.89	3.41	7.10	5.35
	6.37	0.81	7.15	3.70	6.20	6.00
	6.66	1.56	7.42	3.82	5.63	6.91
	6.50	1.82	7.52	4.93	4.20	7.72
	6.56	2.05	7.70	5.01	3.53	8.24

LITHIUM CHLORIDE $\text{LiCl} \cdot \text{H}_2\text{O}$.

SOLUBILITY OF LITHIUM CHLORIDE AND WATER.

CL The results of Hüttig and Rensher, 1924; Benrath, 1927, 1932a; Deacon, 1927; Friend and Culley, 1931; Bassett and Sanderson, 1932; Appleby and Crawford, 1934; and Friend, Hale and Ryder, 1937 were plotted and from the average curve, the following values were taken.

t°	d. of sat. sol.	Gms. LiCl per 100 gms. sat. sol.	Solid Phase	t°	d. of sat. sol.	Gms. LiCl per 100 gms. sat. sol.	Solid Phase
0	1.268	40.9	$\text{LiCl} \cdot 2\text{H}_2\text{O}$	80	1.331	52.8	$\text{LiCl} \cdot \text{H}_2\text{O}$
5	—	42.0	"	90	1.342	54.8	"
10	1.279	42.7	"	96(trpt.)	1.347	56.1	" + LiCl
15	—	43.8	"	97	—	56.8*	$\text{LiCl} \cdot \text{H}_2\text{O}$
18.5(trpt.)	1.293	45.35	" + $\text{LiCl} \cdot \text{H}_2\text{O}$	98	—	57.4*	"
25	1.296	45.85	$\text{LiCl} \cdot \text{H}_2\text{O}$	100	1.347	56.2	LiCl
30	—	46.3	"	110	—	56.7	"
40	1.303	47.3	"	120	1.344	57.2	"
50	1.308	48.3	"	130	—	57.6	"
60	—	49.6	"	140	1.339	58.0	"
70	—	51.1	"	160	—	59.2	"

* metastable

Appleby and Crawford give the transition points as 19.1° and 93°.

LITHIUM CHLORIDE LiCl.

FREEZING-POINTS OF MIXTURES OF LITHIUM CHLORIDE AND WATER

Results of Klein and Svanberg, 1920.		Results of Rodebush, 1918.	
Normality of Aq. LiCl.	F. pt. of solution.	Gms. LiCl per 100 gms. H ₂ O.	F. pt. of solution.
0.1.....	-0.360	5.48.....	-5.11
0.25.....	-0.916	10.68.....	-12.22
0.50.....	-1.897	15.04.....	-18.75
		18.58.....	-25.44

The following determinations of the transition points of Lithium Chloride in Water, made by the freezing-point method, are given by Hüttig and Steudemann, 1927.

t°	Gms. LiCl per 100 gms.		Solid Phase
	H ₂ O	sat. solution	
-80	33.9	25.3	Ice + LiCl.5H ₂ O
-68	40.3	28.7	LiCl.5H ₂ O + LiCl.3H ₂ O
-20	58.4	36.9	LiCl.3H ₂ O + LiCl.2H ₂ O
+12.5	68.0	40.5	LiCl.2H ₂ O + LiCl.H ₂ O
100.5	130.0	56.5	LiCl.H ₂ O + LiCl

SOLUBILITY OF LITHIUM CHLORIDE IN AQUEOUS SOLUTIONS OF HYDROCHLORIC ACID.

Results at 0°. (Engel, 1888.)			Results at 25°. (Herz, 1911-12.)		
Gms. per 100 cc. Sat. Sol.		d ₄ of Sat. Sol.	Gms. per 100 cc. Sat. Sol.		
LiCl.	HCl.		LiCl.	HCl.	
51	0	1.255	57.4	0	
41.4	8.2	1.243	56.87	2.30	
28.5	24.1	1.249	53.64	3.84	
24.6	29.5	1.251	51.98	6.43	

EQUILIBRIUM IN THE SYSTEM LITHIUM CHLORIDE, LITHIUM SULFATE AND WATER
AT 30°. (Schreinemaker and Kayser, 1918.)

Gms. per 100 gms. sat. sol.			Gms. per 100 gms. sat. sol.		
LiCl.	Li ₂ SO ₄ .	Solid Phase.	LiCl.	Li ₂ SO ₄ .	Solid Phase.
46.10	0.0	LiCl.H ₂ O	8.07	12.20	Li ₂ SO ₄ .H ₂ O
45.97	0.0	» + Li ₂ SO ₄ .H ₂ O	5.74	15.71	»
30.74	0.0	Li ₂ SO ₄ .H ₂ O	3.98	18.85	»
21.04	1.08	»	2.76	20.43	»
15.30	4.48	»	0.96	23.60	»
12.06	7.48	»	0.00	25.25	»

LITHIUM CHLORIDE LiCl.

EQUILIBRIUM IN THE SYSTEM LITHIUM CHLORIDE, MANGANESE CHLORIDE AND WATER.

(BenraCh. 1934b.)

°C	Gms. per 100		Solid Phase	°C	Gms. per 100		Solid Phase
	gms. sat. sol.	LiCl			gms. sat. sol.	LiCl	
	MnCl ₂	LiCl			MnCl ₂	LiCl	
0	0.0	40.51	LiCl·2H ₂ O	35	20.07	17.66	MnCl ₂ ·2H ₂ O + MnCl ₂ ·4H ₂ O
"	0.54	40.33	" + 4.1.10	"	31.00	13.76	MnCl ₂ ·4H ₂ O
"	2.35	36.77	4.1.10	"	33.71	10.72	"
"	3.56	35.23	"	"	45.46	0.0	"
"	8.62	32.30	"	60	0.0	49.61	LiCl·H ₂ O
"	10.19	31.10	"	"	1.37	48.68	"
"	11.54	30.24	" + 1.1.5	"	4.31	47.10	"
"	11.63	30.18	1.1.5	"	5.53	46.50	" + 2.1.4
"	13.43	28.53	"	"	9.68	41.07	2.1.4
"	13.45	28.60	" + MnCl ₂ ·4H ₂ O	"	13.61	37.74	"
"	12.48	25.40	MnCl ₂ ·4H ₂ O	"	17.93	33.89	"
"	14.15	22.12	"	"	19.15	33.13	1.1.2
"	27.91	8.84	"	"	23.71	29.09	MnCl ₂ ·2H ₂ O
"	38.86	0.0	"	"	33.00	15.62	"
20	0.0	45.28	LiCl·2H ₂ O + LiCl·H ₂ O	"	41.58	8.14	"
"	0.81	44.67	LiCl·H ₂ O + 4.1.10	"	51.60	0.0	" + MnCl ₂ ·4H ₂ O
"	0.86	44.53	4.1.10	80	0.0	52.88	LiCl·H ₂ O
"	3.73	39.26	"	"	5.25	49.47	"
"	9.09	34.82	"	"	7.78	48.33	" + 2.1.2
"	14.39	31.45	"	"	8.94	47.10	2.1.2
"	16.47	30.41	"	"	9.44	46.37	"
"	17.25	29.65	" + 1.1.5	"	12.16	43.72	" + 1.1.2
"	18.26	28.50	1.1.5	"	17.82	36.79	1.1.2
"	19.13	27.65	"	"	21.62	33.28	"
"	19.91	26.74	MnCl ₂ ·2H ₂ O	"	27.52	28.23	" + MnCl ₂ ·2H ₂ O
"	22.25	23.82	" + MnCl ₂ ·4H ₂ O	"	35.11	15.02	MnCl ₂ ·2H ₂ O
"	21.28	22.47	MnCl ₂ ·4H ₂ O	"	52.03	0.0	"
"	28.75	11.51	"	99	0.0	55.84	LiCl
"	42.36	0.0	"	"	6.27	51.96	"
35	2.55	45.14	LiCl·H ₂ O + 2.1.4	"	7.28	50.75	" + 2.1.2
"	5.48	40.53	2.1.4	"	8.81	49.47	2.1.2
"	10.66	35.93	"	"	11.23	44.26	"
"	12.99	34.26	"	"	17.83	39.77	"
"	18.86	30.08	"	"	20.63	37.25	" + 1.1.2
"	20.29	29.11	" + MnCl ₂ ·2H ₂ O	"	27.62	30.22	1.1.2
"	21.57	26.40	MnCl ₂ ·2H ₂ O	"	31.77	26.82	" + MnCl ₂ ·2H ₂ O
"	28.77	17.98	"	"	36.15	15.89	MnCl ₂ ·2H ₂ O
				"	53.40	0.0	"

1.1.5 = LiCl·MnCl₂·5H₂O; 4.1.10 = 4LiCl·MnCl₂·10H₂O; 2.1.2 = 2LiCl·MnCl₂·2H₂O; 2.1.4 = 2LiCl·MnCl₂·4H₂O; 1.1.2 = LiCl·MnCl₂·2H₂O.

Incomplete data are also given for the isotherms at 14°, 17.5°, 22°, 27°, 43°, 45°, 65°, 70°, 75°, 90° and 95°.

SOLUBILITY OF LITHIUM CHLORIDE IN AQUEOUS SOLUTIONS OF SODIUM CHLORIDE
AND VICE VERSA AT 25°.

(Smith, Elgersma and Hardenberg, 1924.)

The saturated solutions were analyzed by a viscometric method and also by a modified synthetic method.

Gms. per 100 gms. sat. sol.		Gms. per 100 gms. sat. sol.	
LiCl.	NaCl.	LiCl.	NaCl.
45.8	0.0	33.5	0.3
45.5	0.5	31.6	0.8
41.3	0.4	24.9	2.3
40.1	0.2	17.4	7.3
36.8	0.3	16.9	8.4
35.7	0.3	6.5	19.0
33.5	0.4	0.0	26.4

EQUILIBRIUM IN THE SYSTEM LITHIUM CHLORIDE, NICKEL CHLORIDE AND WATER.

(Benrath, 1932a.)

t°	Gms. per 100 gms. sat. sol.		Solid Phase	t°	Gms. per 100 gms. sat. sol.		Solid Phase
	NiCl ₂	LiCl			NiCl ₂	LiCl	
0	0	40.51	LiCl·2H ₂ O	25	6.98	30.96	NiCl ₂ ·4H ₂ O
"	0.38	40.42	" + 4.1.10	"	10.12	26.90	"
"	2.45	36.24	4.1.10 + NiCl ₂ ·4H ₂ O	"	17.12	19.52	"
"	3.14	33.58	NiCl ₂ ·4H ₂ O	"	27.55	16.43	"
"	4.83	30.57	"	"	26.79	10.58	NiCl ₂ ·6H ₂ O
"	9.08	22.64	NiCl ₂ ·6H ₂ O	"	33.56	4.94	"
"	34.08	0.0	"	"	39.58	0.0	"
17.5	0.0	44.61	LiCl ₂ ·2H ₂ O	50	0	48.18	LiCl·H ₂ O
"	0.28	42.61	4.1.10	"	0.26	48.11	" + 2.1.4
"	0.40	43.97	"	"	1.11	43.36	2.1.4
"	2.33	38.78	"	"	3.59	39.17	"
"	3.84	36.83	NiCl ₂ ·2H ₂ O + NiCl ₂ ·4H ₂ O	"	2.84	40.24	NiCl ₂ ·2H ₂ O
"	9.32	26.65	NiCl ₂ ·4H ₂ O	"	3.87	37.72	"
"	13.64	22.04	"	"	10.97	28.39	"
"	18.49	17.65	"	"	15.12	24.60	"
"	15.99	19.73	NiCl ₂ ·6H ₂ O	"	29.44	12.78	"
"	20.56	14.69	"	"	18.25	21.61	NiCl ₂ ·4H ₂ O
"	37.07	0.0	"	"	22.43	17.38	"
25	0	45.90	LiCl·H ₂ O	"	27.69	12.70	"
"	0.21	45.17	" + 2.1.4	"	35.05	6.60	"
"	0.50	42.92	2.1.4	"	40.20	2.38	"
"	2.46	38.93	"	"	43.17	0.0	"
"	3.11	38.17	" + NiCl ₂ ·2H ₂ O	99.5	0.0	55.84	LiCl
"	3.18	37.85	NiCl ₂ ·2H ₂ O	"	0.55	55.50	" + 1.1.2
"	3.46	37.56	"	"	0.72	54.66	1.1.2
"	4.43	35.95	"	"	1.42	48.66	"
"				"	5.25	40.58	" + NiCl ₂ ·2H ₂ O
"				"	8.49	34.24	NiCl ₂ ·2H ₂ O
"				"	14.86	26.71	"
"				"	28.85	14.49	"
"				"	36.30	8.97	"
"				"	46.71	0.0	"

* Metastable

4.1.10 = 4LiCl·NiCl₂·10H₂O

2.1.4 = 2LiCl·NiCl₂·4H₂O

1.1.2 = LiCl·NiCl₂·2H₂O

Incomplete results are also given for the isotherms at 20°, 30°, 35°, 40.5°, 60° and 75°.

Li LITHIUM LITHIUM CHLORIDE

916

EQUILIBRIUM IN THE SYSTEM LITHIUM CHLORIDE, AMMONIA AND WATER AT 23-25°.

(Collins and Cameron, 1928.)

Gms. per 100		Solid Phase	Gms. per 100		Solid Phase	Gms. per 100		Solid Phase
gms. sat.	sol.		gms. sat.	sol.		gms. sat.	sol.	
LiCl	NH ₃		LiCl	NH ₃		LiCl	NH ₃	
45.4	0.0	LiCl.H ₂ O	51.9	16.70	LiCl.NH ₃	45.3	32.7	LiCl.3NH ₃
46.7	3.1	"	54.7	20.0	"	41.52	35.7	"
48.1	7.9	"	57.0	21.64	"	39.3	35.8	"
50.84	13.88	"	52.57	27.31	"	39.11	38.6	"
50.73	14.86	"	46.1	32.0	LiCl.3NH ₃	37.9	40.4	"
50.81	15.34	LiCl.NH ₃				45.9	33.2	"

The authors also give vapor pressure measurements for the above system at 25° and for the system LiCl + NH₃ at the temperatures 0°, 33°, 45.2°, 54.5°, 58.3°, 66.4°, 74.6° and 86.9°.

100 gms. Liquid Ammonia dissolve 0.538 gm. LiCl at -33.9°. (Johnson and Krumboltz, 1933.)

100 gms. Liquid Ammonia dissolve 1.41 gm. LiCl at 0°. (Linhard and Stephan, 1933, 1934.)

C1

EQUILIBRIUM IN THE SYSTEM LITHIUM CHLORIDE, LEAD CHLORIDE AND WATER AT 25°.

(Deacon, 1927.)

Gms. per 1000 gms. H ₂ O		Solid Phase	Gms. per 1000 gms. H ₂ O		Solid Phase
LiCl	PbCl ₂		LiCl	PbCl ₂	
830.5	0.0	LiCl.H ₂ O	231.6	5.61	PbCl ₂
830.0	17.2	"	156.2	2.58	"
835.0	31.0	"	75.88	1.53	"
835.0	72.0	"	43.77	1.39	"
834.9	101.6	" + PbCl ₂	21.64	1.58	"
794.1	103.4	PbCl ₂	7.16	2.58	"
621.8	94.43	"	6.67	2.68	"
453.9	48.71	"	3.88	4.74	"
329.2	16.36	"	0.0	10.87	"

SOLUBILITY OF LITHIUM CHLORIDE IN AQUEOUS SOLUTIONS OF ETHYL ALCOHOL AT 25°.

(Simmons and Freimuth, 1926.)

Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase
LiCl	C ₂ H ₅ OH		LiCl	C ₂ H ₅ OH	
45.94	0.0	LiCl.H ₂ O	27.19	56.42	LiCl.H ₂ O
44.90	4.45	"	25.43	60.24	"
41.88	12.92	"	23.09	66.77	"
40.65	14.49	"	22.41	68.96	" + LiCl
37.02	24.39	"	22.18	72.98	LiCl
34.17	34.24	"	22.13	74.24	"
30.02	47.43	"	20.18	79.82	"

SOLUBILITY OF LITHIUM CHLORIDE IN AQUEOUS SOLUTIONS OF ALCOHOL AT 25°.
(Pinar de Rubies, 1913-1914.)

The LiCl was determined by titration with AgNO_3 . Solutions saturated by constant agitation for many hours. Solid phase, $\text{LiCl} \cdot \text{H}_2\text{O}$ for all mixtures. The anhydride, LiCl, separates only from the most highly concentrated alcohol solutions.

Gms. per 100 $\text{C}_2\text{H}_5\text{OH}$.	Gms. Sat. Sol. LiCl.	Gms. per 100 $\text{C}_2\text{H}_5\text{OH}$.	Gms. Sat. Sol. LiCl.
0	44.9	50	25.75
10	40.9	60	21.6
20	37.25	70	21.1
30	33.3	75	20.8
40	29.4	80	20.75

SOLUBILITY OF LITHIUM CHLORIDE IN AQUEOUS SOLUTIONS OF URETHAN AT 25°.

(Palitzsch, 1928, 1929.)

Gm. Mols. per 1000 gms. H_2O		Solid Phase	Gm. Mols. per 1000 gms. H_2O		Solid Phase
LiCl	$\text{NH}_2\text{COOC}_2\text{H}_5$		LiCl	$\text{NH}_2\text{COOC}_2\text{H}_5$	
19.92	0.0	LiCl	22.40	9.2954	$\text{LiCl} + \text{NH}_2\text{COOC}_2\text{H}_5$
19.93	0.2463	"	14.73	48.336	$\text{NH}_2\text{COOC}_2\text{H}_5$
20.03	1.1528	"			

SOLUBILITY OF LITHIUM CHLORIDE IN ETHYL ALCOHOL AT DIFFERENT TEMPERATURES. (Turner and Bissett, 1913.)

Cl

t°.	Gms. LiCl per 100 Gms. $\text{C}_2\text{H}_5\text{OH}$.	Solid Phase.	t°.	Gms. LiCl per 100 Gms. $\text{C}_2\text{H}_5\text{OH}$.	Solid Phase.
0	14.42	$\text{LiCl} \cdot 4\text{C}_2\text{H}_5\text{OH}$	20	24.28	LiCl
5	15.04	"	30	25.10	"
10	16.77	"	40	25.38	"
15	18.79	"	50	24.40	"
17	20.31	"	60	23.46	"

SOLUBILITY OF LITHIUM CHLORIDE IN METHYL ALCOHOL.

(Lloyd, Brown, Glynwyn, Bonnel and Jones, 1928.)

t°	Gms. LiCl per 100 gms. CH_3OH	Solid Phase	t°	Gms. LiCl per 100 gms. CH_3OH	Solid Phase
0	45.2	$\text{LiCl} \cdot 3\text{CH}_3\text{OH}$	30	43.8	LiCl
10	44.2	LiCl	40	44.1	"
15	44.0	"	50	44.4	"
20	43.8	"	60	44.6	"

SOLUBILITY OF LITHIUM CHLORIDE IN ACETONE

(Bell, Rowlands, Bamford, Thomas and Jones, 1930.)

t°	Gms. LiCl per 100 gms. CH_3COCH_3	Solid Phase	t°	Gms. LiCl per 100 gms. CH_3COCH_3	Solid Phase
0	1.73	LiCl	30	0.87	LiCl
10	1.48	"	37	0.61	"
18	0.95	"	40	0.69	"
20	1.18	"	50	0.61	"

The values at 18° and at 37° were calculated from specific conductivity measurements by Lannung, 1932.

SOLUBILITY OF LITHIUM CHLORIDE IN SEVERAL SOLVENTS.

Solvent.	Gms. LiCl per 100 Gms. Solvent.	Authority.	Solvent.	t°.	Gms. LiCl per 100 Gms. Solvent.	Authority.
Alcohol:			Alcohol:			
Methyl	25	42.36 (Turner & Bissett, 1913.)	Amyl	25	9.03 (Turner & Bissett, 1913.)	
Ethyl	25	2.54* (Patten & Mott, 1904.)	"	?	7.2 (Andrews & Ende, 1895.)	
Propyl	25	16.22 (Turner & Bissett, 1913.)	"	25	0* (Patten & Mott, 1907.)	
"	?	15.86 (Schlamp, 1894.)	Butyl	25	10.57*	"
"	25	3.86* (Patten & Mott, 1904.)	Glycerol	25	4.32*	"
Allyl	25	4.38*	Phenol	53	1.93*	"

* Fused LiCl used for these determinations.

100 cc. anhydrous hydrazine dissolve 16 gms. LiCl at room temp.

(Welsh and Broderson, 1915.)

SOLUBILITY OF LITHIUM CHLORIDE IN SEVERAL SOLVENTS.

(Laszczynski, 1894; deConinck, 1905.)

In Acetone. (L.)			In Pyridine. (L.)		In Glycol. (de C.)	
t°.	Gms. LiCl per 100 Gms. (CH ₃) ₂ CO.	t°.	Gms. LiCl per 100 Gms. (CH ₃) ₂ CO.	t°.	Gms. LiCl per 100 Gms. C ₂ H ₄ N ₂ .	Gms. LiCl per 100 Gms. Sat. Sol.
0	4.60	46	3.76	15	7.78	15
12	4.41	53	3.12	100	14.26	11
25	4.11	58	2.14			

Cl

SOLUBILITY OF LITHIUM CHLORIDE AT 25° IN MIXTURES OF:

Acetone and Benzene. (Marden and Dover, 1917.)			Ethyl Acetate and Benzene. (Marden and Dover, 1917.)		
Gms. Acetone per 100 Gms. Solvent.	Gms. LiCl per 100 Gms. Solvent.	Gms. Acetone per 100 Gms. Solvent.	Gms. LiCl per 100 Gms. Solvent.	Gms. Ethyl Acetate per 100 Gms. Solvent.	Gms. LiCl per 100 Gms. Solvent.
100	2.30	40	0.088	100	1.78
90	1.69	20	0.019	90	0.147
80	0.966	10	0.009	80	0.028
60	0.234	0	0	70	0.005

DISTRIBUTION OF LITHIUM CHLORIDE BETWEEN WATER AND AMYL ALCOHOL AT 30°.

(Dhar and Datta, 1913.)

Mols. LiCl per Liter.		g. g.	Mols. LiCl per Liter.		g. g.
H ₂ O Layer c ₁ .	Alcohol Layer c ₂ .		H ₂ O Layer c ₁ .	Alcohol Layer c ₂ .	
3.24	0.0347	93.37	2.68	0.0240	111.66
3.06	0.0325	94.15	2.58	0.0275	113.40
2.93	0.0300	97.70	2.34	0.0200	117
2.82	0.0275	102.58	1.84	0.0125	147.2
2.76	0.0250	110.40	0.65	0.0030	216.66

SOLUBILITY OF LITHIUM CHLORIDE IN PYRIDINE.

(Kahlenberg and Krauskopf, 1908)

In Anhydrous Pyridine.

t°.	Gms. LiCl per 100 Gms.		Solid Phase.
	Sat. Sol.	Solvent.	
8	11.31	12.71	LiCl.2C ₅ H ₅ N
28	11.87	13.47	"
40	11.60	13.10	LiCl.C ₅ H ₅ N
60	11.38	12.84	"
80	11.71	13.27	"
100	13.01	14.98	"

tr. temp. about 28°.

In 97% Pyridine + 3% H₂O by Volume.

t°.	Gms. LiCl per 100 Gms.	
	Sat. Sol.	Solvent.
22	12.50	14.31
32	13.70	15.98
45	15.58	18.46
58	16.72	20.08
72	17.12	20.66
97	18.35	22.48

SOLUBILITY OF LITHIUM CHLORIDE IN QUINOLINE.
(Walton and Wise, 1922.)

t°.	Gms. Li Cl per 100 gms. Quinoline.	Solid Phase.	t°.	Gms. Li Cl per 100 gms. Quinoline.	Solid Phase.
0.....	0.1515	(C ₉ H ₇ N) ₂ Li Cl	56.4....	1.1734	(C ₉ H ₇ N) ₂ Li Cl
25.....	0.3538	"	67.....	1.2353	"
40.....	0.6175	"	75.....	0.8180	"
45.....	1.0328	"	96.....	0.4588	"
50.....	1.1107	"			

100 gms. sat. solution of lithium chloride in selenium oxychloride (Se O Cl₂) contain 3.21 gms. Li Cl at 25°.
(Wise, 1923.)

DISTRIBUTION OF LITHIUM CHLORIDE BETWEEN WATER AND AMYL ALCOHOL AT 24°.
(Cavanagh, 1921.)

The mixtures were shaken in sealed tubes of about 600 cc. capacity. One of these was charged 10 times, precisely similarly, and provided a total of 2.5 liters of the amyl alcohol layer. These 10 successive samples of non aqueous equilibrium phase were shaken in turn with one and the same small aqueous phase (100 cc.) in a second tube, and this latter analyzed for Cl by a silver titration method. The procedure consisted essentially in the piece-meal concentration of a large amount of the phase to be analyzed, and the concentration of the Li Cl dissolved therein by a piece-meal extraction of it with water.

Approx. Normality of Li Cl in aq. Phase.	Gm. mols. Li Cl per 1000 gms.		Partition coefficient.
	Aq. phase.	Amyl alcohol phase	
0.05	0.051	0.000152	0.0030
0.10	0.0996	0.0003115	0.00313
0.20	0.198	0.000662	0.00335

Cl

DISTRIBUTION OF LITHIUM CHLORIDE BETWEEN WATER AND AMYL ALCOHOL AT 30°.
(Dhar, 1926 a.)

Normality conc. of Li Cl in		$\frac{C_1}{C_2}$	Normality conc. of Li Cl in		$\frac{C_1}{C_2}$
Aq. layer (C ₁).	Alcoholic layer (C ₂).		Aq. layer (C ₁).	Alcoholic layer (C ₂).	
0.65	0.0030	216.7	2.76	0.0250	110.4
1.86	0.0125	147.2	2.82	0.0275	102.6
2.34	0.0220	117.0	2.93	0.0300	97.7
2.58	0.0225	113.4	3.06	0.0325	94.1
2.68	0.0240	111.7	3.24	0.0347	93.4

100 gms. sat. solution of Li Cl in normal butyl alcohol contain 11.49 gms. Li Cl at 25°, and the density of the sat. solution is $d_{25} = 0.8713$.

(Willard and Smith, 1922, 1923 a.)

Fusion-point data are given for the following systems:

LiCl + KCl	(Schaeffer, 1919.)
" + " + NaCl	(" ")
" + NaCl	(Schaeffer; Zemcznzy and Rimbach, 1910.)
" + LiOH	(Scarpa, 1915.)
" + LiF	(Botschwar, 1933.)
" + MgCl ₂	(Sandonnini, 1913, 1914.)
" + MnCl ₂	(Sandonnini and Scarpa, 1913.)
" + NH ₄ NO ₃	(Perman and Harrison, 1924a.)
" + PbCl ₂	(Tries, 1914.)
" + RbCl	(Richards and Meldrum, 1917; Zemcznzy and Rimbach, 1910; Keitel, 1925.)
" + SrCl ₂	(Sandonnini, 1911, 1911a, 1914.)
" + SnCl	(Rack, 1914.)
" + TiCl	(Sandonnini, 1911, 1914.)

SOLUBILITY OF LITHIUM GOLD CHLORIDE IN WATER.

(Rosenbladt, 1886.)

t°	Gms. LiAuCl_4 per 100 Gms. Solution	t°	Gms. LiAuCl_4 per 100 Gms. Solution	t°	Gms. LiAuCl_4 per 100 Gms. Solution
10	53.1	40	67.3	60	76.4
20	57.7	50	72	70	81
30	62.5			80	85.7

LITHIUM CHLORATE LiClO_3 .

SOLUBILITY OF LITHIUM CHLORATE IN WATER.

(Kraus and Burgess, 1927.)

The determinations were made by observing the temperature at which the last crystal of solid phase disappeared in the melt. Careful control of the temperature and vigorous stirring were necessary. The mixtures were kept under a slight excess pressure of dry nitrogen. The temperatures were read by means of a copper-constantan thermocouple.

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t°	Gms. LiClO_3 per 100 gms. sat. sol.	Solid Phase	t°	Gms. LiClO_3 per 100 gms. sat. sol.	Solid Phase
-8.7	15.76	Ice	3.8	71.89	$\text{LiClO}_3 \cdot \text{H}_2\text{O}$
-13.2	20.73	"	6.0	73.60	"
-17.4	24.44	"	9.1	73.74	"
-23.3	28.68	"	14.0	76.08	"
-30.5	32.71	"	18.9	78.54	"
-36.6	35.38	"	21.0 tr.pt.	81.2	" + γLiClO_3
-40.0	37.00	" + $\text{LiClO}_3 \cdot 3\text{H}_2\text{O}$	-3.2	76.59*	LiClO_3
-37.1	38.10	$\text{LiClO}_3 \cdot 3\text{H}_2\text{O}$	+2.9	77.59*	"
-33.9	39.05	"	8.4	78.33*	"
-15.7	45.35	"	12.8	79.26*	"
-8.8	47.94	"	16.4	79.68*	"
-4.8	50.49	"	22.1	81.68	"
-1.8	51.95	"	27.4	82.17	"
+2.2	54.57	"	32.3	83.43	"
4.8	56.66	"	36.5	84.94	"
6.1	58.16	"	41.5 tr.pt.	86.6	" + βLiClO_3
7.3	60.15	"	36.9	86.27*	βLiClO_3
8.0 m.pt.	62.60	"	43.9	87.17*	γLiClO_3
7.9	63.44	"	48.7	87.0	βLiClO_3
7.4	64.88	"	64.4	88.81	"
6.0	67.18	"	71.9	90.35	"
3.4	69.74	"	86.3	92.45	"
+1.5 Eutec.	71.1	" + $\text{LiClO}_3 \cdot \text{H}_2\text{O}$	95.7	94.05	"
-1.7	72.59*	"	99.0 tr.pt.	94.9	" + αLiClO_3
-3.6	73.74*	"	103.0	95.08	αLiClO_3
-7.6	75.15*	"	107.5	96.01	"
-9.0 Eutec.	75.7*	" + γLiClO_3	115.2	97.43	"
-13.6	77.25*	"	123.0	98.86	"
-25.0 Eutec.	81.0	" + βLiClO_3	127.3 m.pt.	100.00	"

The previous determination of Mylius and Funk, 1897 at 18° is much below, and that of Carlson, 1910, is considerably above the present results.

Additional results agreeing with the above are given by Berg, 1929. This author gives evidence that the γ modification of LiClO_3 is really the hydrate $3\text{LiClO}_3 \cdot \text{H}_2\text{O}$, the existence of which he reported in 1926.

LITHIUM Per CHLORATE $\text{LiClO}_4 \cdot 3\text{H}_2\text{O}$.

SOLUBILITY OF LITHIUM PERCHLORATE IN WATER. .

(Simmons and Ropp, 1928.)

t°	d. of sat. sol.	Gms. LiClO_4 per 100 gas. sat. sol.	Solid Phase	t°	Gms. LiClO_4 per 100 gas. sat. sol.	Solid Phase
0	1.215	29.90	$\text{LiClO}_4 \cdot 3\text{H}_2\text{O}$	92.53	70.33	$\text{LiClO}_4 \cdot 3\text{H}_2\text{O} + \text{LiClO}_4 \cdot \text{H}_2\text{O}$
10	1.236	32.88	"	93.2	70.5	$\text{LiClO}_4 \cdot \text{H}_2\text{O}$
20	1.258	35.95	"	97.3	71.0	"
25	1.269	37.48	"	108.9	72.8	"
30	1.277	38.87	"	120.7	75.0	"
40	1.300	41.97	"	136.9	80.0	"
64.6	—	50.0	"	144.0	82.5	"
77.9	—	55.0	"	148.5	85.0	"
89.2	—	60.0	"	149.0 m.pt.	86.5	"
92.3	—	62.5	"	149.3	87.5	"
94.3	—	65.0	"	144.2	90.0	"
95.1 m.pt.	—	66.32	"	145.75 tr.pt.	—	" + LiClO_4
94.8	—	66.67	"	167.5	91.04	LiClO_4
93.2	—	70.00	"	172.0	91.11	"
92.7	—	70.3	"	236.0 m.pt.	100.00	"

LITHIUM Per CHLORATE $\text{LiClO}_4 \cdot 3\text{H}_2\text{O}$.

ClO

SOLUBILITY OF ANHYDROUS LITHIUM PERCHLORATE IN WATER AND IN OTHER SOLVENTS AT 25° . (Willard and Smith, 1923.)

Solvent.	d of solvent.	d of sat. sol.	Gms. LiClO_4 per 100 gms. sat. sol.
Water.....	—	1.2683	37.385
Methyl alcohol.....	0.78705	1.3849	64.57
Ethyl alcohol.....	0.78517	1.3173	60.28
<i>n</i> Propyl alcohol.....	0.7989	1.2006	51.22
<i>n</i> Butyl alcohol.....	0.8059	1.1326	44.23
<i>iso</i> Butyl alcohol.....	0.7981	1.0602	36.73
Acetone.....	0.7852	1.3233	57.72
Ethyl acetate.....	0.89157	1.3005	48.75
Ethyl ether.....	0.70817	1.2116	53.21

SOLUBILITY OF LITHIUM PERCHLORATE TRIHYDRATE IN SEVERAL SOLVENTS AT 25° . (Willard and Smith, 1928.)

Solvent.	d of sat. sol.	Gms. LiClO_4 per 100 gms. sat. sol.	Solvent.	d of sat. sol.	Gms. LiClO_4 per 100 gms. sat. sol.
Methyl alcohol...	1.1420	60.95	<i>iso</i> Butyl alcohol.	0.8887	18.85
Ethyl alcohol. ...	1.0241	42.16	Acetone.....	1.0965	49.04
<i>n</i> Propyl alcohol.	0.9349	26.82	Ethyl acetate....	1.0492	26.35
<i>n</i> Butyl alcohol..	0.9082	21.40	Ethyl ether.....	0.7091	0.196

SOLUBILITY OF LITHIUM PERCHLORATE TRIHYDRATE IN MIXTURES OF ETHYL ALCOHOL AND ETHYL ACETATE AT 25° . (Smith, 1925.)

Vol. per cent $\text{C}_2\text{H}_5\text{OH}$ in solvent.	Gms. LiClO_4 per 100 gms. sat. sol.	Vol. per cent $\text{C}_2\text{H}_5\text{OH}$ in solvent.	Gms. LiClO_4 per 100 gms. sat. sol.
0.0 ($=\text{CH}_3\text{COO C}_2\text{H}_5$)...	26.35	60.0.....	38.58
10.0.....	31.05	70.0.....	39.79
20.0.....	33.59	80.0.....	40.81
30.0.....	35.10	90.0.....	41.77
40.0.....	36.51	100.0.....	42.16
50.0.....	37.96		

Li LITHIUM

LITHIUM BICHROMATE $\text{Li}_2\text{Cr}_2\text{O}_7 \cdot 2\text{H}_2\text{O}$.SOLUBILITY IN WATER AT 30° .(Schreinemaker—Z. physik. Chem. 55, 79, '06; at 18° , Mylius and Funk—Ber. 30, 1718, '97.)

Composition in Weight per cent:

Of Solution.		Of Residue.		Solid Phase.
% CrO_3 .	% Li_2O .	% CrO_3 .	% Li_2O .	
0.0	7.09	...	...	$\text{LiOH} \cdot \text{H}_2\text{O}$
6.986	7.744	4.322	18.538	"
16.564	8.888	10.089	19.556	"
25.811	10.611	15.479	21.106	"
33.618	12.886	24.305	19.398	"
37.411	14.306	44.555	17.411	$\text{LiOH} \cdot \text{H}_2\text{O} + \text{Li}_2\text{CrO}_4 \cdot 2\text{H}_2\text{O}$
37.588	14.381	36.331	18.552	" "
37.495	13.311	51.075	16.384	$\text{Li}_2\text{CrO}_4 \cdot 2\text{H}_2\text{O}$
40.280	10.858	...	...	"
43.404	11.809	53.793	14.070	$\text{Li}_2\text{CrO}_4 \cdot 2\text{H}_2\text{O} + \text{Li}_2\text{Cr}_2\text{O}_7 \cdot 2\text{H}_2\text{O}$
45.130	9.515	56.085	10.190	$\text{Li}_2\text{Cr}_2\text{O}_7 \cdot 2\text{H}_2\text{O}$
47.945	7.951	58.029	9.238	"
57.031	6.432	65.560	8.733	"
67.731	5.713	71.087	8.513	$\text{Li}_2\text{Cr}_2\text{O}_7 \cdot 2\text{H}_2\text{O} + \text{CrO}_3$
67.814	5.689	80.452	3.780	" "
65.200	4.661	...	...	\text{CrO_3
63.257	2.141	85.914	0.758	"
62.28	...	...	...	"

CrO

A saturated aqueous solution contains:

49.985 per cent Li_2CrO_4 , or 100 grams H_2O dissolve 99.94 grams Li_2CrO_4 at 30° (S.).56.6 per cent $\text{Li}_2\text{Cr}_2\text{O}_7$, or 100 grams H_2O dissolve 130.4 grams $\text{Li}_2\text{Cr}_2\text{O}_7$ at 30° (S.).52.6 per cent Li_2CrO_4 , or 100 grams H_2O dissolve 110.9 grams LiCrO_4 at 18° (M. and F.).Sp. Gr. of sat. solution at $18^\circ = 1.574$.

LITHIUM FLUORIDE LiF

SOLUBILITY OF LITHIUM FLUORIDE IN WATER.

F	t°	g. of sat. sol.	Gms. LiF per 100 gms. H_2O	Authority
	0	—	0.120	(Payne, 1937.)
	18	1.003	0.27	(Mylius and Funk, 1897)
	25	—	0.151	(Carter, 1928.)
	25	—	0.132	(Meyer and Dunkel, 1931.)
	25	0.9984	0.133	(Payne, 1937.)
	35	0.9958	0.135	" "

Solubility of Lithium Fluoride in Liquid Hydrofluoric Acid. Determinations of the Solubility of LiF in liquid HF by Bond and Stowe, 1931, show that the reaction $\text{LiF} + \text{HF} = \text{LiHF}_2$ occurs and the molecular ratio $\text{LiF} : \text{HF}$ in the saturated solution at temperatures between 0° and 40° , is approximately 0.043. This corresponds to 5.59 gms. LiF per 100 gms. HF. Fredenhagen and Cadenbach, 1930, 1931, 1933, found that 2.6 gms. LiF dissolve per 100cc sat. solution of LiF in liquid HF at 18° .

1000 gms. pure Acetone (CH_3COCH_3) dissolve 0.0000033 gm. LiF at 18° and 0.000004 gm. at 37° , as determined by conductivity measurements. (Lannung, 1932.)

Fusion-point data are given for LiF + LiOH and LiI + LiOH by Scarpa, 1915 and for LiF + MgF_2 , by Tacchini, 1924.

LITHIUM Titanium FLUORIDE $\text{Li}_2\text{TiF}_6 \cdot 2\text{H}_2\text{O}$.

SOLUBILITY IN WATER AND IN ETHYL ALCOHOL AT $20\text{--}22^\circ$.

(Oinsberg, 1932.)

Solvent	Gms. Li_2TiF_6 per 100cc Solvent	Solid Phase
Water	about 56	$\text{Li}_2\text{TiF}_6 \cdot 2\text{H}_2\text{O}$
"	48	Li_2TiF_6
98% $\text{C}_2\text{H}_5\text{OH}$	0.035	$\text{Li}_2\text{TiF}_6 \cdot 2\text{H}_2\text{O}$
"	0.030	Li_2TiF_6

LITHIUM GERMANATE $3\text{LiGeO}_3 \cdot \text{H}_2\text{O}$.

100 gms. sat. solution of Lithium Germanate in Water contain 0.84 gm. LiGeO_3 at 25° . (Pugh, 1926.)

LITHIUM IODIDE $\text{LiI} \cdot 3\text{H}_2\text{O}$.

SOLUBILITY IN WATER:

(Kremers, 1858, 1860; ice curve, Jones, 1907.)

t° .	Gms. per 100 Gms.		Solid Phase.	t° .	Gms. per 100 Gms.		Solid Phase.
	Water.	Sat. Sol.			Water.	Sat. Sol.	
-0.296	1.08	1.06	Ice	20	165	62.2	$\text{LiI} \cdot 3\text{H}_2\text{O}$
-1.218	4.36	4.19		25	167	62.6	
-2.70	8.71	8.02	"	30	171	63.1	"
-6.14	17.69	15.03	"	40	179	64.2	"
-16.2	38.31	27.70	"	50	187	65.2	"
-25	48.67	32.72	"	60	202	66.9	"
-59	85.13	46	"	70	230	69.7	"
-60 Eutec.	93	48.2	Ice + $\text{LiI} \cdot 3\text{H}_2\text{O}$	75	263	72.5	"
-60	100	50		75	m. pt.	...	
-40	118	54.13	"	85	m. pt.	...	$\text{LiI} \cdot 2\text{H}_2\text{O}$
-20	134	57.27	"	80	435	81.3	$\text{LiI} \cdot \text{H}_2\text{O}$
0	151	60.2	"	100	481	82.8	"
10	157	61.1	"	120	590	85.5	"

A more recent determination of the Eutectic point for Ice + $\text{LiI} \cdot 3\text{H}_2\text{O}$ by Hüttig and Steudemann, 1927, is -91° and 107 gms. LiI per 100 gms. H_2O .

SOLUBILITY OF LITHIUM IODIDE IN WATER.

(Hüttig and Pohle, 1921.)

t° .	Gms. LiI per 100 gms. H_2O .		Solid Phase.	t° .	Gms. LiI per 100 gms. H_2O .		Solid Phase.
0.....	151		$\text{LiI} \cdot 3\text{H}_2\text{O}$	77.....	437		$\text{LiI} \cdot 2\text{H}_2\text{O} + \text{LiI} \cdot \text{H}_2\text{O}$
19.....	164		"	80.....	433		$\text{LiI} \cdot \text{H}_2\text{O}$
40.....	179		"	88.....	437		"
59.....	200		"	99.....	476		"
75.....	248		"	120.....	588		"
75.....	263		"	130.....	743		"
71.5.....	286		"	130.....	782		"
70.5.....	297		" + $\text{LiI} \cdot 2\text{H}_2\text{O}$	130.....	826		" + $\text{LiI} \cdot \frac{1}{2}\text{H}_2\text{O}$
71.5.....	306		$\text{LiI} \cdot 2\text{H}_2\text{O}$	130.....	835		$\text{LiI} \cdot \frac{1}{2}\text{H}_2\text{O}$
79.....	372		"				

The authors also give vapor pressures and thermo chemical data.

100 gms. sat. sol. of $\text{LiI} \cdot 3\text{H}_2\text{O}$ in Water contain 61.2 gms. LiI at 18° .

(Lannung, 1934.)

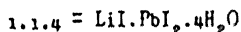
100 gms. sat. sol. of $\text{LiI} \cdot 3\text{H}_2\text{O}$ in Water contain 61.6 gms. LiI at 25° .

EQUILIBRIUM IN THE SYSTEM LITHIUM IODIDE, LEAD
IODIDE AND WATER AT 25°.

(Demassieux and Roger, 1937.)

The results are given in the form of a diagram but the experimental determinations are not reported in the present paper. The following approximate values were estimated from the diagrams.

d. of sat. sol.	Gms. per 100 gms. sat. solution		Solid Phase	d. of sat. sol.	Gms. per 100 gms. sat. solution		Solid Phase
	PbI ₂	LiI			PbI ₂	LiI	
1.815	0.0	62.2	LiI.3H ₂ O	2.160	28.0	40.5	1.1.4
1.885	5.0	55.8	"	2.195	31.91	38.53	" + PbI ₂
1.970	10.0	55.2	"	2.140	30.0	38.0	PbI ₂
2.080	16.0	52.5	"	1.840	22.5	37.0	"
2.160	21.5	50.0	" + 1.1.4	1.590	15.0	35.0	"
2.135	24.0	45.0	1.1.4	1.350	5.5	31.0	"
				1.230	2.0	25.0	"

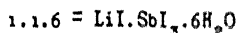


EQUILIBRIUM IN THE SYSTEM LITHIUM IODIDE, ANTIMONY
IODIDE AND WATER.

(Francois and Delvaux, 1936.)

The results are given only in the form of a diagram from which the following approximate values were read.

Results at 13°		Results at 35°		Results at 60°		Solid Phase at each temp.
Gms. per 100 gms. H ₂ O		Gms. per 100 gms. H ₂ O		Gms. per 100 gms. H ₂ O		
SbI ₃	LiI	SbI ₃	LiI	SbI ₃	LiI	
0	160	0	175	0	195	LiI.3H ₂ O
50	162	50	176	50	196	"
75	163	105	176	135	205	" + 1.1.6
65	130	95	150	125	185	1.1.6
55	110	85	120	115	155	"
70	80	95	100	125	135	"
85	50	80	130	150	115	"



DISTRIBUTION OF LITHIUM IODIDE BETWEEN WATER AND
NITROBENZENE AT 25°.

(Robertson, 1933.)

Gm. Mols. LiI per liter		W NB
H ₂ O layer (W)	C ₆ H ₅ NO ₂ layer (NB)	
4.55	0.00140	3250
2.38	0.00222	1070
1.57	0.00363	430
1.11	0.00141	790
0.82	0.00222	1200

SOLUBILITY OF LITHIUM IODIDE IN SEVERAL SOLVENTS.

Solvent.	t°.	Gms. LiI per 100 Gms. Solvent.	Authority.
Methyl Alcohol	25	343.4	(Turner and Bissett, 1913.)
Ethyl Alcohol	25	250.8	" "
Propyl Alcohol	25	47.52*	" "
Amyl Alcohol	25	112.5	" "
Glycol	15.3	38.9	(de Coninck, 1905.)
Furfural	25	45.9†	(Walden, 1906.)
Nitromethane	0	1.22†	"
"	25	2.52	"

* Solid phase = $\text{LiI} \cdot \frac{1}{2} \text{C}_3\text{H}_7\text{OH}$.

† = gms. per 100 cc. sat. solution.

100 gms. pure Acetone (CH_3COCH_3) dissolve 42.56 gms. LiI at 18° and 75.25 gms. at 37° as determined by electrical conductivity. (Lannung, 1932.)

F.-pt. data for LiI + AgI are given by Sandonnini and Scarpa, 1913.

LITHIUM IODOMERCURATE $2\text{LiI} \cdot \text{HgI}_2 \cdot 6\text{H}_2\text{O}$.

100 gms. sat. solution of lithium iodomercurate in water prepared by cooling a hot solution and allowing to stand at 24.7° for 3 months, contained 1.30 gms. Li, 27.4 gms. Hg, 58 gms. I and 13.3 gms. H_2O ; Sp. Gr. of the sat. sol. = 3.28. (Dubois, 1905.)

LITHIUM IODATE $\text{Li}(\text{IO}_3) \cdot \frac{1}{2} \text{H}_2\text{O}$.

100 gms. H_2O dissolve 80.3 gms. LiIO_3 at 18°, or 100 gms. solution contain 44.6 grams. Sp. gr. of sol. = 1.568. (Mylius and Funk, 1897.)

LITHIUM PERMANGANATE $\text{LiMnO}_4 \cdot 3\text{H}_2\text{O}$

100 gms. water dissolve 71.4 gms. permanganate at 16°.

(Ashoff)

LITHIUM MOLYBDATE $4\text{Li}_2\text{MoO}_4 \cdot 3\text{H}_2\text{O}$.

SOLUBILITY OF LITHIUM MOLYBDATE IN WATER.

(Rosenheim and Reglin, 1921.)

t°	Gms. Li_2MoO_4 per 100 gms. sat. sol.	Solid Phase	t°	Gms. Li_2MoO_4 per 100 gms. sat. sol.	Solid Phase
0	45.24	$4\text{Li}_2\text{MoO}_4 \cdot 3\text{H}_2\text{O}$	30	44.26	$4\text{Li}_2\text{MoO}_4 \cdot 3\text{H}_2\text{O}$
20	44.30	"	40	43.84	"
25	44.81	"	98	42.50	"

The result at 20° is by Wempe, 1913.

Fusion-point data for mixtures of $\text{Li}_2\text{MoO}_4 + \text{MoO}_3$ and $\text{LiMoO}_4 + \text{Na}_2\text{MoO}_4$ are given by Hoermann, 1929.

Li LITHIUM

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LITHIUM NITRIDE $\text{LiN}_3 \cdot \text{H}_2\text{O}$.

SOLUBILITY OF LITHIUM NITRIDE IN WATER.
(Roller and Wohlgemuth, 1934.)

t°	Gms. LiN_3 per 100 gms. sat. sol.	Solid Phase	t°	Gms. LiN_3 per 100 gms. sat. sol.	Solid Phase
-10	10.0	Ice	+18	40.0	$\text{LiN}_3 \cdot \text{H}_2\text{O}$
-30	20.0	"	40	43.0	"
-47.5 Eutec.	26.0	" + $\text{LiN}_3 \cdot 4\text{H}_2\text{O}$	68.2 tr. pt.	48.0	" + LiN_3
-31 tr. pt.	33.5	$\text{LiN}_3 \cdot 4\text{H}_2\text{O} + \text{LiN}_3 \cdot \text{H}_2\text{O}$	100	50.0	LiN_3
0	38.0	$\text{LiN}_3 \cdot \text{H}_2\text{O}$			

The results in the above table, except those for the eutectic and the tr.pts., were estimated approximately from the authors' diagram. The preceding results of Curtius and Rissom, 1898, are considered to be in error except the value for 16° which agrees fairly well with the above.

LITHIUM NITRITE $\text{LiNO}_2 \cdot \text{H}_2\text{O}$.

SOLUBILITY IN WATER. (Oswald, 1911)

t°	Gms. LiNO_2 per 100 Gms. Sat. Sol.	Solid Phase.	t°	Gms. LiNO_2 per 100 Gms. Sat. Sol.	Solid Phase.
-7.5	11.1	Ice	38.5	55.5	$\text{LiNO}_2 \cdot \text{H}_2\text{O}$
-11.7	15	"	42	56.0	"
-21	21.2	"	49	60.6	"
-28.8	29	"	49.5	61.2	" + $\text{LiNO}_2 \cdot \text{H}_2\text{O}$
-31.3	29.4	" + $\text{LiNO}_2 \cdot \text{H}_2\text{O}$	65	63.8	$\text{LiNO}_2 \cdot \text{H}_2\text{O}$
-19.3	33.9	$\text{LiNO}_2 \cdot \text{H}_2\text{O}$	81.5	68.7	"
0	41.5	"	91	72.4	"
+19	48.9 ($d_{19}=1.3186$)	"	96	91.8	"
25	50.9	"	92.5	94.3	"

100 gms. H_2O dissolve 10.5 gms. AgNO_3 + 78.5 gms. LiNO_2 at 14° . (Oswald, 1914)

Recent determinations of the Solubility of Lithium Nitrite by Bureau, 1935, 1937, gave the following results, differing from the above.

t°	Gms. LiNO_2 per 100 gms. sat. sol.	Solid Phase	t°	d. of sat. sol.	Gms. LiNO_2 per 100 gms. sat. sol.	Solid Phase
-4.9	7.01	Ice	18.4	1.116	46.6	$\text{LiNO}_2 \cdot \text{H}_2\text{O}$
-10.25	12.31	"	34.7	1.158	55.85	"
-24.25	21.08	"	50.9	—	63.0	" + $\text{LiNO}_2 \cdot \text{H}_2\text{O}$
-38.7 Eutec.	26.58	" + $\text{LiNO}_2 \cdot 1\frac{1}{2}\text{H}_2\text{O}$	56.0	1.433	65.5	$\text{LiNO}_2 \cdot 1\frac{1}{2}\text{H}_2\text{O}$
-22.7	32.9	$\text{LiNO}_2 \cdot 1\frac{1}{2}\text{H}_2\text{O}$	66.0	1.458	66.4	"
-10.95	40.5	"	79.5	1.495	70.2	"
-7.95	43.5	" + $\text{LiNO}_2 \cdot \text{H}_2\text{O}$	94.0	—	75.9	" + LiNO_2
+1.0	44.0	$\text{LiNO}_2 \cdot \text{H}_2\text{O}$	99.0	1.545	76.4	LiNO_2

LITHIUM NITRATE $\text{LiNO}_3 \cdot 3\text{H}_2\text{O}$.

SOLUBILITY IN WATER. (Donnan and Burt, 1903.)

t°.	Gms. LiNO_3 per 100 Gms. Solution.	Solid Phase.	t°.	Gms. LiNO_3 per 100 Gms. Solution.	Solid Phase.
0.1	34.8	$\text{LiNO}_3 \cdot 3\text{H}_2\text{O}$	29.87	56.42	$\text{LiNO}_3 \cdot 3\text{H}_2\text{O}$
10.5	37.9	"	29.86	56.68	"
12.1	38.2	"	29.64	57.48	"
13.75	39.3	"	29.55	58.03	"
19.05	40.4	"	43.6	60.8	$\text{LiNO}_3 \cdot \frac{1}{2}\text{H}_2\text{O}$
22.1	42.9	"	50.5	61.3	"
27.55	47.3	"	55	63	"
29.47	53.67	"	60	63.6	"
29.78	55.09	"	64.2	64.9	LiNO_3 .
			70.9	66.1	"

The eutectic Ice + $\text{LiNO}_3 \cdot 3\text{H}_2\text{O}$, is at -17.8° and about 33 gms. LiNO_3 per 100 gms. sat. sol. Transition points, 29.6° and 61.1° .

Data for the system $\text{LiNO}_3 + \text{Li}_2\text{SO}_4 + \text{H}_2\text{O}$ at 0° , 30° and 70° are given by Massink, 1916.

EQUILIBRIUM IN THE SYSTEM LITHIUM NITRATE, LITHIUM SULFATE AND WATER AT 25° AND AT 35° . (Massink, 1918.)

Gms. per 100 gms. sat. sol.			Gms. per 100 gms. sat. sol.			Gms. per 100 gms. sat. sol.		
LiNO_3	Li_2SO_4	Solid Phase.	LiNO_3	Li_2SO_4	Solid Phase.	LiNO_3	Li_2SO_4	Solid Phase.
Results at 25° .								
47.58	0.0	$\text{LiNO}_3 \cdot 3\text{H}_2\text{O}$	59.65	0.0	Li_2SO_4	19.25	7.41	$\text{Li}_2\text{SO}_4 \cdot \frac{1}{2}\text{H}_2\text{O}$
47.60	± 0.0	" + $\text{Li}_2\text{SO}_4 \cdot \frac{1}{2}\text{H}_2\text{O}$	57.91	± 0.0	" + $\text{Li}_2\text{SO}_4 \cdot \frac{1}{2}\text{H}_2\text{O}$	19.12	7.50	"
43.45	0.19	$\text{Li}_2\text{SO}_4 \cdot \frac{1}{2}\text{H}_2\text{O}$	52.03	0.0	$\text{Li}_2\text{SO}_4 \cdot \frac{1}{2}\text{H}_2\text{O}$	16.79	9.25	"
33.90	1.14	"	50.55	0.0	" + $\text{Li}_2\text{SO}_4 \cdot \frac{1}{2}\text{H}_2\text{O}$	12.31	13.13	"
18.64	8.41	"	49.54	0.08	"	8.98	16.10	"
0.0	25.79	"	41.83	0.17	"	4.99	20.48	"
Results at 35° .								
59.49	0.0	$\text{LiNO}_3 \cdot \frac{1}{2}\text{H}_2\text{O}$	28.63	2.06	"	3.04	22.19	"
61.93	0.0	LiNO_3	23.18	5.16	"	1.48	23.88	"
61.97	± 0.0	" + Li_2SO_4	20.14	6.78	"	0.76	24.55	"
					"	0.0	25.79	"
					"	11.1.17	11.1.17	"
					"	9.1.27	9.1.27	"

SOLUBILITY OF LITHIUM NITRATE IN AQUEOUS SOLUTIONS OF LEAD NITRATE AT 25° AND VICE VERSA.

(Malquori, 1928)

Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase
LiNO_3	$\text{Pb}(\text{NO}_3)_2$		LiNO_3	$\text{Pb}(\text{NO}_3)_2$	
45.83	0.0	$\text{LiNO}_3 \cdot 3\text{H}_2\text{O}$	21.54	9.36	$\text{Pb}(\text{NO}_3)_2$
44.75	2.47	"	10.88	15.50	"
40.45	2.65	" + $\text{Pb}(\text{NO}_3)_2$	0.97	33.20	"
33.96	5.10	$\text{Pb}(\text{NO}_3)_2$	0.57	33.12	"
29.15	6.30	"	0.0	37.07	"
28.36	8.65	"			

EQUILIBRIUM IN THE SYSTEM LITHIUM NITRATE, TERTIARY BUTYL ALCOHOL AND WATER AT 25° .

(Ginnings, Herring and Webb, 1933.)

The composition of the homogeneous mixture (plait point) of the three compounds as determined by the synthetic method is 16.0 gms. LiNO_3 + 23.0 gms. tertiary Butyl Alcohol, $(\text{CH}_3)_3\text{COH}$, per 100 gms. sat. solution. The original results for the remaining points on the binodal curve are not given but only the values corresponding to derived empirical equations for the curve.

LITHIUM NITRATE

SOLUBILITY OF LITHIUM NITRATE IN LIQUID AMMONIA, DETERMINED BY THE SYNTHETIC METHOD.

(Purton and Dillewicht, 1929.)

t°	Gms. LiNO_3 per 100 gms. sat. sol.	Solid Phase	t°	Gms. LiNO_3 per 100 gms. sat. sol.	Solid Phase	t°	Gms. LiNO_3 per 100 gms. sat. sol.	Solid Phase
-77.7	0.0	NH_3	-28.5	40.51	I + II	15.5	60.24	Li_2LiNO_3
-77.8	3.03	"	-12.0	42.97	"	25.0	70.0	LiNO_3
-79.0	10.73	"	-5.5	49.28	"	25.0	(70.89)	"
-80.5	21.74	"	-3.0	52.82	"	42.0	71.59	"
-78.5	24.26	Li.8	-3.0	56.96	" + Li.2	119.0	75.35	"
-62.0	30.62	"	+ 7.0	62.7	Li.2	160.0	82.60	"
-53.0	33.51	"		66.38	"	204.0	89.61	"
-54.0	35.66	Li.4				264.0	100.00	"

Li.8 = $\text{LiNO}_3 \cdot 8\text{NH}_3$; Li.4 = $\text{LiNO}_3 \cdot 4\text{NH}_3$; Li.2 = $\text{LiNO}_3 \cdot 2\text{NH}_3$. The authors also give results for the densities of solutions of LiNO_3 in NH_3 at 26°. The results at 25° in parentheses above are by Hunt and Boneyk, 1933.

SOLUBILITY OF LITHIUM NITRATE IN ACETIC ACID, DETERMINED BY THE SYNTHETIC METHOD.

(Davidson and Beer, 1920.)

t°	Mol. Percent LiNO_3	Solid Phase	t°	Mol. Percent LiNO_3	Solid Phase	t°	Mol. Percent LiNO_3	Solid Phase
16.6	0.0	CH_3COOH	12.80	7.693*	CH_3COOH	16.7	12.64	LiNO_3
16.3	0.156	"	11.80	9.384*	"	82.6	14.66	"
16.03	0.983	"	10.92	10.110*	"	91.6	15.66	"
15.71	2.013	"	39.0	9.48	LiNO_3	101.0	17.08	"
15.0	4.115	"	46.3	10.33	"	118.3	19.84	"
14.46	5.305	"	54.2	11.26	"	142.2	22.34	"

* Metastable

A saturated solution of Lithium Nitrate in Acetone contains 0.343 gm. mols. = 23.67 gms. LiNO_3 per liter at about 20°. (Brashers-Krug and Lewis, 1911.)

SOLUBILITY OF LITHIUM NITRATE IN SEVERAL SOLVENTS (Muller, R., 1921.)

Solvent	Gms. LiNO_3 per 100 cc. solvent at 20°
Acetonitrile.....	0.991
Iso amyl alcohol.....	0.5
Pyridine.....	37.14

EQUILIBRIUM IN THE SYSTEM LITHIUM NITRATE AND UREA.

(Howells, 1931.)

t°	Gms. LiNO ₃ per 100 gms. Mixture	Solid Phase	t°	Gms. LiNO ₃ per 100 gms. Mixture	Solid Phase	t°	Gms. LiNO ₃ per 100 gms. Mixture	Solid Phase
132.0	0.0	CO(NH ₂) ₂	71.0	18.8	Co(NH ₂) ₂ + 1.2	123.7	39.39	1.2
126.7	2.78	"	64.1	19.83*	"	132.0	42.25	"
122.3	4.67	"	44.7	22.98*	"	113.2	46.36	"
113.9	7.93	"	106.8	25.68	1.2	104.1	48.63	"
105.0	10.79	"	113.5	27.89	"	100.6	50.38	"
102.9	11.31	"	117.5	29.56	"	98.5	50.00	" + LiNO ₃
90.1	14.53	"	122.5	32.6	"	121.3	52.85	LiNO ₃
74.0	19.52	"	125.9	35.92	"	127.9	54.10	"
						146.4	57.07	"

* Metastable. 1.2 = LiNO₃·2CO(NH₂)₂.

Fusion-point data are given for:

LiNO₃ + Li₂SO₄ (Amadori, 1913.)" + NaNO₃ (Carveth, 1898; Lehrman and Breslow, 1938.)" + RbNO₃ (Puschin and Radoicic, 1937.)" + TlNO₃ (Briscoe, Evans, and Robinson, 1932.)LITHIUM OXIDE Li₂OFusion-point data for the System Li₂O + V₂O₅ are given by Gaunerl, 1928.LITHIUM HYDROXIDE LiOH·H₂O.

SOLUBILITY IN WATER.

(Dittmar, 1888; Pickering, 1893.)

OH

t°.	Gms. per 100 Gms. Solution.		Gms. LiOH per 100 Gms. H ₂ O.	t°.	Gms. per 100 Gms. Solution.		Gms. LiOH per 100 Gms. H ₂ O.
	Li ₂ O	LiOH.			Li ₂ O	LiOH	
-10.5	...	7.23	...	30	7.05	11.27	12.0
-18 Eutec.	...	11.2	...	40	7.20	11.68	13
0	6.67	10.64	12.7	50	7.56	12.12	13.3
10	6.74	10.80	12.7	60	7.96	12.76	13.8
20	6.86	10.99	12.8	80	8.87	14.21	15.3
25	6.95	11.14	12.9	100	10.02	16.05	17.5

100 gms. sat. solution of LiOH·H₂O in Water contain 10.7 gms. LiOH at 0°; (Rollet and Lauffenburger, 1934.); 11.35 gms. at 25° (Van Meurs, 1916); 11.0 gms. at 25° (Heda, 1933.)

SOLUBILITY OF LITHIUM HYDROXIDE IN AQUEOUS SOLUTIONS OF LITHIUM SULFOANTIMONATE AT 30° AND VICE VERSA.

(Donk, 1908.)

Gms. per 100 Gms. Sat. Sol.		Solid Phase.	Gms. per 100 Gms. Sat. Sol.		Solid Phase.
LiOH.	Li ₂ SbS ₄ .		LiOH.	Li ₂ SbS ₄ .	
11.4	0	LiOH·H ₂ O	2.1	48.3	LiOH·H ₂ O
9.1	8.3	"	2.1	52.1	" (Li ₂ SbS ₄ ·10H ₂ O)
2.3	29.9	"	1.4	51.8	Li ₂ SbS ₄ ·nH ₂ O
			0	51.3	"

EQUILIBRIUM IN THE SYSTEM LITHIUM HYDROXIDE, PHENOL AND WATER AT 25°.
(Van Meurs, 1916.)

Mols. per 100 mols. sat. sol.		Solid Phase.	Mols. per 100 mols. sat. sol.		Solid Phase.
LiOH.	C ₆ H ₅ OH.		LiOH.	C ₆ H ₅ OH.	
8.79	0.0	LiOH.H ₂ O	4.36	30.48	C ₆ H ₅ O.Li.2H ₂ O
8.30	0.23	"	3.85	45.05	"
8.25	0.41	" + C ₆ H ₅ O.Li.2H ₂ O	3.56	51.34	"
5.26	1.02	C ₆ H ₅ O.Li.2H ₂ O	2.32	68.19	"
2.64	2.37	"	2.08	68.71	"
3.25	7.72	"	2.11	70.42	" + C ₆ H ₅ OH
3.79	14.38	"	2.14	71.91	"
4.28	22.64	"	1.82	73.11	C ₆ H ₅ OH

At concentrations of Li OH below 0.25 mol. per cent, liquid layers with the following composition are formed.

Aqueous layer.		Phenol layer.	
Mol. % LiOH.	Mol. % C ₆ H ₅ OH.	Mol. % LiOH.	Mol. % C ₆ H ₅ OH.
0.0	1.79	0.0	32.33
0.23	3.34	0.35	17.97

LITHIUM PHOSPHATES, Li₃PO₄, LiH₂PO₄.

100 gms. sat. solution of neutral Lithium phosphate in water contain 0.022 gm. Li₃PO₄ at 0° and 0.030 gm. at 20°.

100 gms. sat. solution of acid Lithium phosphate in water contain 55.8 gms. LiH₂PO₄ at 0°. (Rollet and Lauffenburger, 1934.)

EQUILIBRIUM IN THE SYSTEM LITHIUM OXIDE, PHOSPHORUS
PENTOXIDE AND WATER.

(Rollet and Lauffenburger, 1934.)

Results at 0°

Results at 20°

Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase
P ₂ O ₅	Li ₂ O		P ₂ O ₅	Li ₂ O		P ₂ O ₅	Li ₂ O	
0.0	6.71	LiOH.H ₂ O	2.74	0.74	Li ₃ PO ₄	0.017	7.05	LiOH.H ₂ O + Li ₃ PO ₄
0.015	6.72	" + Li ₃ PO ₄	11.03	2.55	"	0.0165	0.077	Li ₃ PO ₄
0.02	5.58	Li ₃ PO ₄	17.2	3.90	"	0.0210	0.0134	"
0.016	2.40	"	20.26	4.58	"	0.0272	0.0165	"
0.02	0.49	"	22.16	4.37	"	0.0345	0.0197	"
0.0148	0.0088	"	24.30	5.42	"	0.0360	0.0203	"
0.0163	0.0098	"	31.13	6.86	"	0.116	0.050	"
0.0375	0.0185	"	34.43	7.55	"	0.242	0.0965	"
0.058	0.025	"	37.95	8.19	LiH ₂ PO ₄	0.305	0.118	"
0.388	0.149	"	38.10	8.08	"	0.409	0.150	"
0.414	0.167	"	38.20	7.68	"	0.620	0.205	"
0.452	0.174	"	38.45	7.54	"	0.875	0.262	"
0.635	0.2285	"	38.85	7.18	"	27.5	5.73	"
0.782	0.266	"	47.5	4.62	"	37.1	7.63	"
0.80	0.270	"	53.05	3.21	"	38.8	7.98	"
0.96	0.33	"	55.65	2.74	"	41.6	8.45	" + LiH ₂ PO ₄
1.355	0.403	"	58.8	2.22	"	41.7	7.73	LiH ₂ PO ₄
1.88	0.520	"			"	43.5	6.62	"

LITHIUM PHOSPHATE Li_3PO_4 .

Aqueous solutions of lithium phosphate are colloidal and cannot be obtained clear. A solubility determination made by electrolytic conductivity gave 0.297 gm. Li_3PO_4 per liter sat. solution at 25°. (Rosenheim and Reglin, 1921.)

LITHIUM Sub PHOSPHATE $\text{Li}_2\text{PO}_3 \cdot 3\frac{1}{2}\text{H}_2\text{O}$.

100 gms. sat. solution of lithium subphosphate in water contain 0.1018 gm. Li_2PO_3 at 0°, 0.0575 gm. at 25° and 0.048 gm. at 40°. These determinations are only approximately correct since it was impossible to obtain the saturated solution in a clear condition either by long standing or by filtration. A determination made by electrolytic conductivity gave 0.1267 gm. Li_2PO_3 per liter sat. sol. in water at 25°. (Rosenheim and Reglin, 1921.)

LITHIUM Hydrogen PHOSPHITE $\text{Li}_2\text{HPO}_3 \cdot \text{H}_2\text{O}$.

PO

SOLUBILITY OF LITHIUM HYDROGEN PHOSPHITE IN WATER. (Rosenheim and Reglin, 1921.)

t°.	Gms. Li_2HPO_3 per 100 gms. sat. sol.	Solid Phase.	t°.	Gms. Li_2HPO_3 per 100 gms. sat. sol.	Solid Phase.
0.....	9.07	$\text{Li}_2\text{HPO}_3 \cdot \text{H}_2\text{O}$	45.....	6.29	$\text{Li}_2\text{HPO}_3 \cdot \text{H}_2\text{O}$
25.....	7.47	"	51.....	6.09	"
30.....	7.07	"	61.....	5.75	"
35.....	6.82	"	98.....	4.24	"
40.....	6.64	"			

LITHIUM (Hypo) PHOSPHATE $\text{Li}_4\text{P}_2\text{O}_6 \cdot 7\text{H}_2\text{O}$.

100 gms. H_2O dissolve 0.83 gm. hypophosphate at ord. temp. (Rammelsberg, 1892.)

LITHIUM SULFIDE Li_2S

Fusion-point data are given for $\text{Li}_2\text{S} + \text{S}$ by Pearson and Robinson, 1931.

LITHIUM Antimony SULFIDE $\text{Li}_3\text{SbS}_4 \cdot 10\text{H}_2\text{O}$.

SOLUBILITY OF LITHIUM ANTIMONY SULFIDE IN WATER AND IN AQUEOUS ALCOHOL.

S

In Water. (Donk, 1908.)			In Aqueous Alcohol at 10° and 30°.			
t°.	Gms. Li_3SbS_4 per 100 Gms. Sat. Sol.	Solid Phase.	t°.	Gms. per 100 Gms. Sat. Sol.	Solid Phase.	Authority.
				$\text{C}_2\text{H}_5\text{OH}$	Li_3SbS_4	
- 1.7	7.1	Ice	10	10.7	41.8	$\text{Li}_3\text{SbS}_4 \cdot 10\text{H}_2\text{O}$ (Donk, 1908.)
- 3.2	12.8	"	10	26.2	36.5	"
- 5.1	17.5	"	10	66.2	20.6	"
-10.8	23.2	"	30	13.3	46.3	$\text{Li}_3\text{SbS}_4 \cdot 8\frac{1}{2}\text{H}_2\text{O}$
-15.9	28.5	"	30	51.9	30.7	"
-26.2	35.3	"	30	54.8	29.9	"
-42	40.4	Ice + $\text{Li}_3\text{SbS}_4 \cdot 10\text{H}_2\text{O}$	30	58.4	30.8	"
0	45.5	$\text{Li}_3\text{SbS}_4 \cdot 10\text{H}_2\text{O}$	30	58.6	32.3	" + Li_3SbS_4
+10	46.9	"	30	65.26	29.31	Li_3SbS_4
30	50.1	"	30	74.3	24.1	"
50	51.3	"	30	79.5	20.5	"

(Schreine-
makers and
Jacobs,
1910.)

LITHIUM SULFATE $\text{Li}_2\text{SO}_4 \cdot \text{H}_2\text{O}$.

SOLUBILITY OF LITHIUM SULFATE IN WATER.

(Friend, 1929.)

t°	Gms. Li_2SO_4 per 100 gms. sat. sol.	Solid Phase	t°	Gms. Li_2SO_4 per 100 gms. sat. sol.	Solid Phase
-16.0	27.32	$\text{Li}_2\text{SO}_4 \cdot 2\text{H}_2\text{O} (?)$	35.0	24.76 (1)	$\text{Li}_2\text{SO}_4 \cdot \text{H}_2\text{O}$
-13.0	27.24	"	38.0	25.28	"
-11.5	27.18	"	43.7	25.00	"
-6.5	26.73	$\text{Li}_2\text{SO}_4 \cdot \text{H}_2\text{O}$	51.6	24.82	"
0.0	25.43 (1)	"	52.4	24.71	"
0.0	26.33 (2)	"	55.	24.62 (2)	"
0.6	26.51	"	65.7	24.34	$\text{Li}_2\text{SO}_4 \cdot \text{H}_2\text{O}$
14.0	26.07	"	77.0	24.05	"
16.7	25.96	"	94.8	23.76	"
19.6	25.85	"	94.9	23.4 (1.182) (4)	"
25	25.50 (2)	"	100.1	23.5 (1.179) (4)	"
25	25.79 (3)	"	103.0	23.72	"
31.8	25.47	"	104.0	23.55 (1.176) (4)	"

(1) Sanders and Dobbins, 1931; (2) Crockford and Webster, 1930;

(3) Massink, 1917-18; (4) Applebey, Crawford and Gordon, 1934.

The figures in parentheses are densities.

SOLUBILITY OF LITHIUM SULFATE IN AQUEOUS SOLUTIONS
OF SULFURIC ACID AT 12.5° .

(Montemartini and Losana, 1929.)

d. of sat. sol.	Gms. per 100 gms. sat. sol.	Solid Phase	d. of sat. sol.	Gms. per 100 gms. sat. sol.	Solid Phase
	Li_2SO_4 H_2SO_4			Li_2SO_4 H_2SO_4	
1.2401	25.68 0.0	$\text{Li}_2\text{SO}_4 \cdot \text{H}_2\text{O}$	1.4021	8.76 42.20	$\text{Li}_2\text{SO}_4 + \text{Li}_2\text{SO}_4 \cdot \text{H}_2\text{O}$
1.2498	22.75 8.75	"	1.5008	8.14 54.10	" + $\text{LiHSO}_4 \cdot \text{H}_2\text{O}$
1.2712	19.32 15.74	"	1.6278	12.12 68.93	$\text{LiHSO}_4 \cdot \text{H}_2\text{O}$
1.2992	15.82 23.73	"	1.7210	13.46 66.24	"
1.3263	13.35 28.36	"	1.8154	10.08 75.58	LiHSO_4
1.3618	10.42 38.12	" + Li_2SO_4	1.8998	12.42 87.02	" + $\text{LiHSO}_4 \cdot \text{H}_2\text{SO}_4$

SOLUBILITY OF LITHIUM SULFATE IN Aq. H_2SO_4 AT 30° . (van Dorp, 1910)

Gms. per 100 Gms. Sat. Sol.	Solid Phase	Gms. per 100 Gms. Sat. Sol.	Solid Phase
H_2SO_4 Li_2SO_4		H_2SO_4 Li_2SO_4	
5.05 22.74	$\text{Li}_2\text{SO}_4 \cdot \text{H}_2\text{O}$	55.08 13.69	Li_2SO_4
12.23 20.45	"	61.46 17.10	"
16.60 19.10	"	62.49 18.89	$\text{Li}_2\text{SO}_4 \cdot \text{H}_2\text{SO}_4$
32.70 13.37	"	69.40 13.75	"
42.98 10.57	"	78.23 11.64	"
52.72 11.44	"	83.43 15.05	"

SOLUBILITY OF LITHIUM SULFATE IN ABSOLUTE SULFURIC ACID.

(Bergius, 1910)

10 cc. sat. solution in abs. H_2SO_4 contain 2.719 gms. Li_2SO_4 and the crystalline solid phase has the composition $\text{Li}_2\text{SO}_4 \cdot 7\text{H}_2\text{SO}_4$ and melts at about 12° .Freezing-point data for mixtures of $\text{Li}_2\text{SO}_4 + \text{H}_2\text{SO}_4$ are given by Kendall and Landon, 1920.

SOLUBILITY OF AMMONIUM SULFATE IN AQUEOUS SOLUTIONS OF LITHIUM SULFATE AND VICE VERSA.

(Schreinemakers, Cocheret, Filippo and deWaal, 1905, 1907.)

Results at 30°.

Gms. per 100 Gms. Sat. Solution.	Solid Phase.
$(\text{NH}_4)_2\text{SO}_4$	
44.1	$(\text{NH}_4)_2\text{SO}_4$
40.8	
39.5	$(\text{NH}_4)_2\text{SO}_4 + \text{NH}_4\text{LiSO}_4$
30	NH_4LiSO_4
21.6	"
15	"
12.5	$\text{NH}_4\text{LiSO}_4 + \text{Li}_2\text{SO}_4 \cdot \text{H}_2\text{O}$
8.9	$\text{Li}_2\text{SO}_4 \cdot \text{H}_2\text{O}$
0	"

Results at 50°.

Gms. per 100 Gms. Sat. Solution.	Solid Phase.
$(\text{NH}_4)_2\text{SO}_4$	
45.7	$(\text{NH}_4)_2\text{SO}_4$
43.05	$(\text{NH}_4)_2\text{SO}_4 + \text{NH}_4\text{LiSO}_4$
19.65	NH_4LiSO_4
13.90	"
13.97	$\text{NH}_4\text{LiSO}_4 + \text{Li}_2\text{SO}_4 \cdot \text{H}_2\text{O}$
11.45	$\text{Li}_2\text{SO}_4 \cdot \text{H}_2\text{O}$
9.63	"
8.58	"
7.56	"
0	"

Additional data for the triple points of the above system at 20°, 57° and 97° are given by Spielrein (1913), but the terms in which the results are presented are not clearly shown.

Data for the quaternary system, ammonium sulfate, lithium sulfate, alcohol and water at 6.5°, 30° and 50° are given by Schreinemakers and van Dorp (1907).

A mixture of an excess of ammonium and of potassium sulfates in water at 19° was found by Rüdorff (1873) to contain 37.97 gms. $(\text{NH}_4)_2\text{SO}_4$ + 39.3 gms. K_2SO_4 per 100 gms. sat. solution. SO

SOLUBILITY OF LITHIUM SULFATE IN AQUEOUS ALCOHOL AT 30°.

(Schreinemakers and van Dorp, Jr., 1906.)

Gms. per 100 Gms. Sat. Sol.	Solid Phase.	Gms. per 100 Gms. Sat. Sol.	Solid Phase.
$\text{C}_2\text{H}_5\text{OH}$		$\text{C}_2\text{H}_5\text{OH}$	
0	$\text{Li}_2\text{SO}_4 \cdot \text{H}_2\text{O}$	47.28	$\text{Li}_2\text{SO}_4 \cdot \text{H}_2\text{O}$
11.75	"	58.59	"
21.19	"	69.39	"
29.40	"	80.74	"
33.31	"	94.11	"

Fusion-point data are given for:

$\text{Li}_2\text{SO}_4 + \text{Ag}_2\text{SO}_4$	(Nacken, 1907b.)
" + K_2SO_4	(Nacken, 1907.)
" + MnSO_4	(Calcagni and Marotta, 1914.)
" + Na_2SO_4	(Nacken, 1907.)
" + SrSO_4	(Calcagni and Marotta, 1912.)

LITHIUM Ammonium SULFATE LiNH_4SO_4 .

SOLUBILITY IN WATER.

(Schreinemakers, Cocheret, Filippo and deWaal, 1905, 1907.)

t°.	Gms. NH_4LiSO_4 per 100 Gms. Sat. Sol.	Solid Phase.	t°.	Gms. NH_4LiSO_4 per 100 Gms. Sat. Sol.	Solid Phase.
0	0	Ice	-10	35.25	NH_4LiSO_4
-5	14	"	+10	35.58	"
-10	23.5	"	30	25.87	"
-15	29.7	"	50	36	"
-20.6 Eutec.	35.15	Ice + NH_4LiSO_4	70	36.18	"

Li LITHIUM

934

SOLUBILITY OF LITHIUM-POTASSIUM SULFATE IN WATER. (Spielrein, 1913.)

t°.	Gms. per 100 cc. Sat. Sol.		Solid Phase.	t°.	Gms. per 100 cc. Sat. Sol.		Solid Phase.
	Li ₂ SO ₄ .	K ₂ SO ₄ .			Li ₂ SO ₄ .	K ₂ SO ₄ .	
20	35.6	3.6	Li ₂ SO ₄ .K ₂ SO ₄ +Li ₂ SO ₄	60	10.6	16.3	Li ₂ SO ₄ .K ₂ SO ₄ +K ₂ SO ₄
20	13.3	13.1	" +K ₂ SO ₄	98	30.2	9.3	" +Li ₂ SO ₄
60	32.5	6	" +Li ₂ SO ₄	98	9	23	" +K ₂ SO ₄

SOLUBILITY OF LITHIUM-SODIUM SULFATES IN WATER. (Spielrein, 1913.)

t°.	Gms. per 100 cc. Sat. Sol.		Solid Phase.	t°.	Gms. per 100 cc. Sat. Sol.		Solid Phase.
	Li ₂ SO ₄ .	Na ₂ SO ₄ .			Li ₂ SO ₄ .	Na ₂ SO ₄ .	
0	31.4	5.9	Li ₂ SO ₄ .Na ₂ SO ₄ .3½H ₂ O+Li ₂ SO ₄	33.5	25.8	13.9	Li ₂ SO ₄ .Na ₂ SO ₄ .3H ₂ O+Li ₂ SO ₄
0	18.5	11.4	" +Na ₂ SO ₄	33.5	13.9	21.8	" +Na ₂ SO ₄
7.5	20.4	11.17	" (triple pt.)	53	28	16.6	" +Li ₂ SO ₄
16	32	9.3	"	53	16.7	27.3	" +Na ₂ SO ₄
24	26	14.9	Li ₂ SO ₄ .Na ₂ SO ₄ .12H ₂ O+Li ₂ SO ₄	99	27.4	14.4	" +Li ₂ SO ₄
24	16.5	21.4	" +Na ₂ SO ₄	99	14.4	25.1	" +Na ₂ SO ₄
32	20	16.8	" (triple pt.)				

There is some uncertainty as to whether all of the above results are in terms of grams per 100 cc. or per 100 gms. of sat. solution.

SeO

LITHIUM SELENITE 4Li₂SeO₃.3H₂O.

SOLUBILITY OF LITHIUM SELENITE IN WATER. (Rosenheim and Krause, 1921.)

t°.	0°.	25°.	45°.	60°.	100°.
Gms. Li ₂ SeO ₃ per 100 gms. sat. sol. . . .	19.99	16.76	14.53	12.75	9.05

LITHIUM SILICATE (ortho) Li₄SiO₄.

Fusion-point data for mixtures of Li₄SiO₄ + Ca₂SiO₄ and for Li₄SiO₄ + ZrSiO₄ are given by Schwarze and Haacke, 1921.

LITHIUM STANNATE Li₂Sn(OH)₆.

SOLUBILITY OF LITHIUM STANNATE AND OF HYDRATED LITHIUM STANNATE IN WATER. (Zocher, 1920.)

SnO

t°.	Gms. Li ₂ SnO ₃ per 100 gms. sat. sol. in presence of	
	Li ₂ Sn(OH) ₆	Li ₂ Sn(OH) ₆ .2H ₂ O.
28.....	1.14	2.08
40.....	3.25	2.02
61.....	3.66	2.58
80.....	4.36	2.99

LITHIUM VANADATE Li₃VO₄.9H₂O

SOLUBILITY OF LITHIUM VANADATE IN WATER. (Rosenheim and Heglin, 1921.)

t°.	Gms. Li ₃ VO ₄ per 100 gms. sat. sol.	Solid Phase.	t°.	Gms. Li ₃ VO ₄ per 100 gms. sat. sol.	Solid Phase.
0.0	2.40	Li ₃ VO ₄ .9H ₂ O	38.4	5.09	Li ₃ VO ₄ .H ₂ O
20.8	4.60	"	40.0	4.20	"
28.6	5.25	"	45.0	3.70	"
30.2	5.91	"	50.0	2.80	"
35.2	6.25	"	60.0	2.60	"

WO

LITHIUM TUNGSTATE Li₂WO₄.

Fusion-point data for mixtures of Li₂WO₄ + K₂WO₄, Li₂WO₄ + Na₂WO₄, and Li₂WO₄ + WO₃ are given by van Liempt, 1925. Hoermann, 1929.

LUTETIUM see Cassiopeium

THE SOLUBILITY OF MAGNESIUM AND OF MAGNESIUM ALLOYS
IN AQUEOUS SALT SOLUTIONS AND SEA WATER.

(Whitby, 1932, 1933.)

A method based upon the oxygen absorbed and hydrogen evolution was developed. No absorption of oxygen could be detected but the evolution of hydrogen could be accurately measured in samples of gas periodically removed from above the corroding liquid. Large variations in rate of dissolution of different grades of Mg, containing varying traces of impurities in 0.1 n to 3.0 n NaCl and 0.05 n HCl, was encountered. The presence of 0.02 percent Mn causes an acceleration of attack with time. The rate of attack in sea water was lower, due to the presence of sulfates. Traces of saponin increase the rate of H evolution. Three magnesium-base alloys and one type of duraluminum gave substantially the same results as pure Mg. Non metallic impurities such as inclusions of nitride or oxide do not act either as cathodes or nuclei for anodic attack in NaCl solutions. The initial rate of dissolution of Mg in H_2O , conc. and dilute solutions of KCl, KBr, KI and K_2SO_4 and in aqueous solutions of alkali is always practically the same. A theory of "primary preferential hydroxyl ion discharge" is proposed and supported by free energy calculations.

100 gms. sat. solution of magnesium in mercury contain 0.323 gm. Mg at 25°.

(Loomis, 1922.)

Data for the distribution of magnesium between aluminium and lead and between aluminium and bismuth are given by Tammann and Schaftmeister, 1924.

Fusion-points of mixtures of Mg + Hg are given by Cambi and Speroni, 1915.

MAGNESIUM ARSENATE.

Data for equilibrium in the system magnesium oxide, arsenic trioxide and water at 25° are given by Story and Anderson, 1924.

MAGNESIUM BROMIDE $MgBr_2 \cdot 6H_2O$.

Br

SOLUBILITY OF MAGNESIUM BROMIDE IN WATER.

(Oetman, 1935.)

t°	Gms. $MgBr_2$ per 100 gms. H_2O	Solid Phase	t°	Gms. $MgBr_2$ per 100 gms. H_2O	Solid Phase
- 3.92	12.08	Ice	+ 10.4	99.3	$MgBr_2 \cdot 6H_2O$
- 6.85	18.36		19.9	101.1	
-15.2	32.86		24.8	103.3	
-37.5	53.93		29.8	103.9	
-42.7 Eutec	58.20		34.8	105.4	
-23.0	68.6		39.8	106.5	
-15.0	73.6		60.1	112.0	
- 9.0	78.7		65.5	114.5	
- 7.0	79.7		100.0	125.4	
- 6.0	81.2		172.4 m.pt.	170.4	
- 0.83 tr.pt.	97.7	" + $MgBr_2 \cdot 6H_2O$			

d. of sat. sol. at 18° = 1.655 (Mylius & Funk, 1897.)

The previous results of Menschutkin, 1906, are shown to be too low.

Mg MAGNESIUM

936

SOLUBILITY OF MAGNESIUM BROMIDE IN AQUEOUS SOLUTIONS OF HYDROBROMIC ACID AT 25 .

(Scott and Durham, 1930.)

Gms. per 100 gms. sat. sol.		Solid Phase
HBr	MgBr ₂	
0.0	49.93	MgBr ₂ ·6H ₂ O
4.70	45.40	"
9.83	40.33	"
14.79	35.55	"

100 gms. sat. solution of Magnesium Bromide in Liquid Ammonia contain 0.004 gm. MgBr₂ at 0°. (Linhard and Stephan, 1933, 1934.)

100 cc. acetonitrile dissolve 13.35 gms. Mg Br₂ at 25°. (Muller, R., 1924.)

100 cc. pyridine dissolve 0.49 gms. Mg Br₂ at 18°, 0.54 gms. at 25° and 2.5 gms. at 60°. (Muller R., 1924.)

Fusion point data for mixtures of Mg Br₂ + K Br and Mg Br₂ + Na Br are given by Kellner, 1917.

SOLUBILITY OF MAGNESIUM BROMIDE IN ETHYL ETHER.

(Rowley, 1936.)

The author made a very careful study of the factors influencing the accuracy of the results, including the effect of moisture and of light. The very greatest care is required to obtain accurate results. The values are considerably lower than those of Menschutkin.

Br	t°	Gms. MgBr ₂ per 100 gms. (C ₂ H ₅) ₂ O	Solid Phase	t°	Gms. MgBr ₂ per 100 gms. (C ₂ H ₅) ₂ O	Solid Phase
-20	0.22		MgBr ₂ ·3(C ₂ H ₅) ₂ O	20	2.50	MgBr ₂ ·2(C ₂ H ₅) ₂ O
-10	0.40		"	22	2.91	
0	0.70		"	0	2.04	
+10	1.18		"	+10	2.47	Immiscible Liquid Phase
14	1.58		MgBr ₂ ·2(C ₂ H ₅) ₂ O	20	2.95	
16	1.84		"	30	3.49	
18	2.14		"			

MAGNESIUM BROMIDE ETHERATES, ALCOHOLATES, ACIDATES, ETC.

SOLUBILITIES RESPECTIVELY IN ETHER, ALCOHOL, ACIDS, ETC., AT VARIOUS TEMPERATURES.

(Boris N. Menschutkin. Monograph in the Russian language entitled "On Etherates and Other Molecular Combinations of Magnesium Bromide and Iodide" St. Petersburg, 1907, pp. 267 and XLVIII. Also published in the Memoirs of the St. Petersburg Polytechnic Institute, Vols. 17, 1904-1907, and in condensed form in Vols. 49-62 of the Zeit. anorg. Chem., 1906-1909.)

Preparation of Material. The dietherate of magnesium bromide, MgBr₂·2(C₂H₅)₂O (Z. anorg. Chem., 49, 31, '06) was prepared by the very gradual addition of bromine to a cold mixture of magnesium powder and dry ether. It is very hygroscopic and is stable only under its ethereal solution. It is decomposed by water and reacts with very many organic compounds as alcohols, acids, ketones, esters, aldehydes, etc. The addition products thus formed constitute the material employed in the author's succeeding studies. The monoetherate of magnesium bromide, MgBr₂·(C₂H₅)₂O, was prepared just as the dietherate, but the temperature during crystallization was kept above 30°, at which point the dietherate is converted to monoetherate. It is also precipitated by dry ligroin.

Method of Determination of Solubility. At temperatures below 30° the determinations were made by agitating an excess of the salt with the solvent and analyzing the saturated solution. At the higher temperatures the synthetic (sealed tube) method of Alexejff (Wied. Ann., 1885) was used. See also Magnesium Iodide Etherates

MAGNESIUM BROMIDE ETHERATES

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MAGNESIUM Mg

SOLUBILITY OF MAGNESIUM BROMIDE DIETHERATE, $\text{MgBr}_2 \cdot 2(\text{C}_2\text{H}_5)_2\text{O}$, AND OF
MAGNESIUM BROMIDE ETHERATE, $\text{MgBr}_2 \cdot (\text{C}_2\text{H}_5)_2\text{O}$, IN ETHYL ETHER, $(\text{C}_2\text{H}_5)_2\text{O}$,
AT VARIOUS TEMPERATURES.

(Menschutkin. See preceding page.)

Solubility of the Dietherate in Ether.

t°.	Gms. per 100 Gms. Sat. Sol.		Mols. MgBr_2 . $2(\text{C}_2\text{H}_5)_2\text{O}$ per 100 Mols. Sat. Sol.
	$\text{MgBr}_2 \cdot 2(\text{C}_2\text{H}_5)_2\text{O}$.	MgBr_2 .	
- 8	1.08	0.6	0.24
0	1.44	0.8	0.32
+ 10	2.3	1.27	0.52
14	2.95	1.64	0.67
16	3.48	1.93	0.80
18	4.14	2.3	0.96
20	4.86	2.7	1.125
22.8	6.3	3.5	1.6
Two liquid layers separate between these con- centrations of $\text{MgBr}_2 \cdot 2(\text{C}_2\text{H}_5)_2\text{O}$.			
23	72.3	40.1	36.8
24	75.3	41.8	40.5
26	79.5	44.1	46.6
28.5	84.2	46.7	54.2
30	85.5	47.4	56.9

Solubility of the Monoetherate in Ether.

t°.	Gms. per 100 Gms. Sat. Sol.		Mols. MgBr_2 . $(\text{C}_2\text{H}_5)_2\text{O}$ per 100 Mols. Sat. Sol.
	$\text{MgBr}_2 \cdot (\text{C}_2\text{H}_5)_2\text{O}$.	MgBr_2 .	
0	68.8	49.1	28.1
20	67.2	47.9	27.1
30	66.5	47.3	26.6
40	65.5	46.7	26.1
60	63.8	45.5	25.1
80	62.1	44.3	24.2
100	60.7	43.3	23.5
120	59.6	42.5	22.9
140	58.5	41.7	22.3
158	57.5	41	21.9
Two liquid layers separate between these con- centrations of $\text{MgBr}_2 \cdot (\text{C}_2\text{H}_5)_2\text{O}$.			
158	5.8	4.15	1.6
158	4.8	3.4	1.36
159	1.96	1.4	0.56
162	0.38	0.27	0.11
170	0.18	0.13	0.05

Br

At 22.8° and 158° the saturated solutions of the dietherate and monoetherate, respectively, separate into two liquid layers which have at the intervening temperatures the following composition. Determinations of the specific gravity of the lower layer gave $d_{17}^{20} = 1.1628$ and $d_{33}^{20} = 1.1492$.

t°.	Gms. per 100 Gms. Solution.			
	Lower Layer.		Upper Layer.	
	$\text{MgBr}_2 \cdot 2(\text{C}_2\text{H}_5)_2\text{O}$.	MgBr_2 .	$\text{MgBr}_2 \cdot 2(\text{C}_2\text{H}_5)_2\text{O}$.	MgBr_2 .
- 10	75.75	42	3.2	1.8
0	73.9	41	4.1	2.3
+ 10	72.2	40.1	5	2.8
20	70.8	39.3	5.9	3.3
30	69.8	38.7	6.8	3.8
40	68.8	38.2	7.7	4.3
50	68	37.8	8.5	4.7
60	67.7	37.6	9.2	5.1
70	67.7	37.6	9.7	5.4
80	68	37.8	10	5.6
90	68.6	38.1	10.2	5.7
100	69.4	38.5	10.4	5.8
120	71	39.3	10.1	5.6
140	72.4	40.15	9.2	5.1
158	74	41	7.8	4.3

unstable
"
stable

SOLUBILITY OF ETHYL, METHYL, PROPYL, ETC., ALCOHOLATES OF MAGNESIUM BROMIDE IN THE RESPECTIVE ALCOHOLS. (Menschutkin, 1907.)

These compounds were all prepared by the action of magnesium bromide dietherate upon the several alcohols. The ether was expelled and the new alcoholate addition product recrystallized from the respective alcohol. The solubility determinations were made by the synthetic method.

Solubility of $\text{MgBr}_2 \cdot 6\text{C}_2\text{H}_5\text{OH}$ in Methyl Alcohol.			Solubility of $\text{MgBr}_2 \cdot 6\text{C}_2\text{H}_5\text{OH}$ in Ethyl Alcohol.			Solubility of $\text{MgBr}_2 \cdot 6\text{C}_3\text{H}_7\text{OH}$ in Propyl Alcohol.			Solubility of $\text{MgBr}_2 \cdot 6 \text{ Iso C}_4\text{H}_9\text{OH}$ in Iso Butyl Alcohol.		
t°.	Gms. $\text{MgBr}_2 \cdot 6\text{C}_2\text{H}_5\text{OH}$ per 100 Gms. Sat. Sol.		t°.	Gms. $\text{MgBr}_2 \cdot 6\text{C}_2\text{H}_5\text{OH}$ per 100 Gms. Sat. Sol.		t°.	Gms. $\text{MgBr}_2 \cdot 6\text{C}_3\text{H}_7\text{OH}$ per 100 Gms. Sat. Sol.		t°.	Gms. $\text{MgBr}_2 \cdot 6\text{C}_4\text{H}_9\text{OH}$ per 100 Gms. Sat. Sol.	
0	42.6			17.2			77.9		0	55.8	
20	44.6	0	10	24.9		10	81.5	10	60.5		
40	46.7	20	30	32.7		20	85.1	20	65.2		
60	48.9	30	40	40.3		30	88.5	30	69.8		
80	51.4	40	50	47.8		40	92	40	74.3		
100	55.5	60	60	62.2		43	93	50	78.5		
120	60.7	80	70	73.8		46	94.3	60	82.4		
140	66.8	90	80	78.7		48	95.8	65	84.2		
160	74	100	90	86.7		50	97.8	71	88		
180	84.5	103	100	90		52 m. pt.	100	75	92		
185	88	106	106	94.4				77	94.6		
190 m. pt.	100		108.5 m. pt.	100				80 m. pt.	100		

Solubility of $\text{MgBr}_2 \cdot 6 \text{ Iso C}_4\text{H}_9\text{OH}$ in Iso Amyl Alcohol.			Solubility of $\text{MgBr}_2 \cdot 4(\text{CH}_3)_2\text{CHOH}$ in Dimethyl Carbinol.			Solubility of $\text{MgBr}_2 \cdot 4(\text{CH}_3)_3\text{COH}$ in Trimethyl Carbinol.		
t°.	Gms. $\text{MgBr}_2 \cdot 6\text{C}_4\text{H}_9\text{OH}$ per 100 Gms. Sat. Sol.		t°.	Gms. $\text{MgBr}_2 \cdot 4(\text{CH}_3)_2\text{CHOH}$ per 100 Gms. Sat. Sol.		t°.	Gms. $\text{MgBr}_2 \cdot 4(\text{CH}_3)_3\text{COH}$ per 100 Gms. Sat. Sol.	
0	70.2		0	40		24.7 m. pt. of $(\text{CH}_3)_3\text{COH}$		
10	75.6		20	42.2		24.4 Eutec.	0.06	
20	80.2		40	45		25	1	
30	84.5		60	48.5		35	9.5	
35	86.7		80	53.3		45	19.1	
38	88.7		100	59		55	32.2	
40	90		120	67.3		60	40.5	
42	92		130	74		70	62.5	
44	94.2		136	83.6		75	77	
46 m. pt.	100		138	90		79	91.5	
			139 m. pt.	100		80 m. pt.	100	

MAGNESIUM BROMIDE ANILINATES.

SOLUBILITY OF MAGNESIUM BROMIDE ANILINATES IN ANILINE AT DIFFERENT TEMPERATURES. (Menschutkin, 1907.)

The compounds were formed by the action of aniline on magnesium bromide dietherate. The three compounds were: $\text{MgBr}_2 \cdot 6\text{C}_6\text{H}_5\text{NH}_2$, $\text{MgBr}_2 \cdot 4\text{C}_6\text{H}_5\text{NH}_2$ and $\text{MgBr}_2 \cdot 2\text{C}_6\text{H}_5\text{NH}_2$.

t°.	Gms. $\text{MgBr}_2 \cdot 6\text{C}_6\text{H}_5\text{NH}_2$ per 100 Gms. Sat. Sol.	Solid Phase.	t°.	Gms. $\text{MgBr}_2 \cdot 4\text{C}_6\text{H}_5\text{NH}_2$ per 100 Gms. Sat. Sol.	Solid Phase.
10	3.2	$\text{MgBr}_2 \cdot 6\text{C}_6\text{H}_5\text{NH}_2$	160	26	$\text{MgBr}_2 \cdot 4\text{C}_6\text{H}_5\text{NH}_2$
50	5.1	"	180	28.3	"
70	7.5	"	200	33.5	"
90	12.8	"	220	45	"
100	18.5	"	230	55	"
103.5	27.5	"	237 tr. pt.	76.3	"
103 tr. pt.	24	$\text{MgBr}_2 \cdot 4\text{C}_6\text{H}_5\text{NH}_2$	250	77.3	$\text{MgBr}_2 \cdot 2\text{C}_6\text{H}_5\text{NH}_2$
120	24.3	"	260	78.1	"
140	24.3	"	270	79	"

MAGNESIUM BROMIDE**MAGNESIUM BROMIDE PHENYLHYDRAZINATES.**

SOLUBILITY OF MAGNESIUM BROMIDE. PHENYLHYDRAZINATES IN PHENYLHYDRAZINE.

(Menschutkin, 1907.)

(Approximate determinations.)

t°.	Gms. MgBr ₂ . 6C ₆ H ₅ NHNH ₂ per 100 Gms. Sat. Sol.	Solid Phase.	t°.	Gms. MgBr ₂ . 6C ₆ H ₅ NHNH ₂ per 100 Gms. Sat. Sol.	Solid Phase.
20	3	MgBr ₂ .6C ₆ H ₅ NHNH ₂	100	54.8	MgBr ₂ .4C ₆ H ₅ NH.NH ₂
40	7	"	140	60.8	"
60	16.4	"	180	68.4	"
80	33	"	200	73.4	"
99	54.8	"			"

MAGNESIUM BROMIDE COMPOUNDS with Benzaldehyde and with Acetone-

SOLUBILITY RESPECTIVELY IN BENZALDEHYDE AND IN ACETONES.

(Menschutkin, 1907.)

The compounds were prepared by the action of benzaldehyde and of acetone on magnesium bromide dietherate. On account of the nature of the compounds the results are only approximately correct.

Solubility of MgBr₂.3C₆H₅COH
in Benzaldehyde.

Solubility of MgBr₂.3CH₃.CO.CH₃.
in Acetone.

Br

t°.	Gms. MgBr ₂ . 3C ₆ H ₅ COH per 100 Gms. Sat. Sol.	t°.	Gms. MgBr ₂ . 3C ₆ H ₅ COH per 100 Gms. Sat. Sol.	t°.	Gms. MgBr ₂ . 3CH ₃ .CO.CH ₃ . per 100 Gms. Sat. Sol.	t°.	Gms. MgBr ₂ . 3CH ₃ .CO.CH ₃ . per 100 Gms. Sat. Sol.
0	0.7	140	17.8	0	0.2	75	50
30	1.3	145	37.5	30	0.8	76	71.6
60	1.9	146	65	60	1.45	80	83.3
100	3.4	148	84.5	70	2	84	89.8
120	6	153	93.2	73	5.5	88	95.2
130	9.5	159 m. pt.	100	74	14	92 m. pt.	100

MAGNESIUM BROMIDE COMPOUNDS with Methylal, Ortho Ethylformate, Formic Acid and Acetic Acid.

(Menschutkin, 1907a.)

The compounds were prepared by the action of methylal, ortho ethylformate and absolutely dry formic and acetic acids on magnesium dietherate. In the case of the latter compounds the results are only approximately correct, due to their extreme hygroscopicity.

Solubility of MgBr₂.2CH₃(OCH₃)₂ in Methylal. Solubility of MgBr₂.2CH(OC₂H₅)₂ in Orthoethylformate. Solubility of MgBr₂.6HCOOH in Formic Acid. Solubility of MgBr₂.6CH₃COOH in Acetic Acid.

t°.	Gms. MgBr ₂ . 2CH ₃ (OCH ₃) ₂ per 100 Gms. Sat. Sol.	t°.	Gms. MgBr ₂ . 2CH(OC ₂ H ₅) ₂ per 100 Gms. Sat. Sol.	t°.	Gms. MgBr ₂ . 6HCOOH per 100 Gms. Sat. Sol.	t°.	Gms. MgBr ₂ . 6CH ₃ COOH per 100 Gms. Sat. Sol.
20	0.3	0	11.1	0	49.8	17	0.3
40	0.45	20	12.5	20	57.5	30	1.5
60	0.6	40	14.8	40	65.1	50	4.5
80	0.75	60	18.6	60	73.1	60	7.9
100	0.9	80	25.7	70	78.1	70	16.2
106	1.1	90	35	80	86	80	38.5
2 liquid layers here		95	41	86	95	90	57.7
106	86.2	100	50	88 m. pt.	100	100	71.8
108	90.8	105	66			105	80
110	95.4	110	88.5			110	89.5
112 m. pt.	100	114 m. pt.	100			112 m. pt.	100

Mg MAGNESIUM

MAGNESIUM BROMIDE COMPOUNDS with Acetamide, Acetanilide and Acetic Anhydride. (Menschutkin, 1909.)

The compounds were prepared by reaction with magnesium bromide dietherate.

Solubility of $\text{MgBr}_2 \cdot 6\text{CH}_3\text{CONH}_2$ in Acetamide.			Solubility of $\text{MgBr}_2 \cdot 6\text{CH}_3\text{CONHC}_6\text{H}_5$ in Acetanilide.			Solubility of $\text{MgBr}_2 \cdot 6(\text{CH}_3\text{CO})_2\text{O}$ in Acetic Anhydride.		
t°.	Gms. $\text{MgBr}_2 \cdot 6\text{CH}_3\text{CONH}_2$ per 100 Gms. Sat. Sol.	Solid Phase.	t°.	Gms. $\text{MgBr}_2 \cdot 6\text{CH}_3\text{CONHC}_6\text{H}_5$ per 100 Gms. Sat. Sol.	Solid Phase.	t°.	Gms. $6(\text{CH}_3\text{COO})_2\text{O}$ per 100 Gms. Sat. Sol.	Solid Phase.
82 m. pt.	of CH_3CONH_2	CH_3CONH_2	112 m. pt.	of $\text{CH}_3\text{CONHC}_6\text{H}_5$		0	26.4	
80	3.1	"	110	3.7	$\text{CH}_3\text{CONHC}_6\text{H}_5$	20	28.7	
70	21.7	"	108	7.7	"	40	31.6	
60	40	"			" + $\text{MgBr}_2 \cdot \text{CH}_3\text{CONHC}_6\text{H}_5$	60	35.7	
50.5*	56	$\text{CH}_3\text{CONH}_2 + \text{MgBr}_2 \cdot \text{CH}_3\text{CONH}_2$	107.5*	9		80	41.1	
			120	13.1	$\text{MgBr}_2 \cdot \text{CH}_3\text{CONHC}_6\text{H}_5$	100	48.4	
70	57.8	$\text{MgBr}_2 \cdot \text{CH}_3\text{CONH}_2$	140	19.3	"	120	57.8	
90	60.5	"	160	25.5	"	130	69.8	
110	65	"	180	35.3	"	133	77	
130	71.5	"	200	59.5	"	135	85	
150	80	"	205	73.2	"	136.5†	100	
160	85	"	207	82.5	"			
165	90	"	209	100†	"			
169†	100	"						

* Eutec.

† m. pt.

Br

MAGNESIUM BROMIDE COMPOUNDS with Urethan and with Urea.

(Menschutkin, 1909.)

Solubility of Magnesium Bromide Urethan Compounds in Urethan.

Solubility of Magnesium Bromide Urea Compounds in Urea.

Solubility of Magnesium Bromide Urethan Compounds in Urethan.			Solubility of Magnesium Bromide Urea Compounds in Urea.		
t°.	Gms. $\text{MgBr}_2 \cdot 4\text{C}_2\text{H}_5\text{OCONH}_2$ per 100 Gms. Sat. Sol.	Solid Phase.	t°.	Gms. $\text{MgBr}_2 \cdot 4\text{CO}(\text{NH}_2)_2$ per 100 Gms. Sat. Sol.	Solid Phase.
49 m. pt.	of urethan	$\text{C}_2\text{H}_5\text{OCONH}_2$	132 m. pt.	of urea	$\text{CO}(\text{NH}_2)_2$
45	18.5	"	126	9.5	"
39	36.5	"	120	17.2	"
35*	43.3	" + $\text{MgBr}_2 \cdot 6\text{C}_2\text{H}_5\text{OCONH}_2$	114	21.8	"
50	45.6	$\text{MgBr}_2 \cdot 6\text{C}_2\text{H}_5\text{OCONH}_2$	108.5*	24.2	$\text{CO}(\text{NH}_2)_2 + \text{MgBr}_2 \cdot 6\text{CO}(\text{NH}_2)_2$
70	51.3	"	115	29.8	$\text{MgBr}_2 \cdot 6\text{CO}(\text{NH}_2)_2$
80	56.2	"	120	35	"
90	66.5	"	127	45.5	"
91.5	75.5	"	130	60	"
91†	69.4	" + $\text{MgBr}_2 \cdot 4\text{C}_2\text{H}_5\text{OCONH}_2$	130†	58	" + $\text{MgBr}_2 \cdot 4\text{CO}(\text{NH}_2)_2$
100	73.8	$\text{MgBr}_2 \cdot 4\text{C}_2\text{H}_5\text{OCONH}_2$	145	60.7	$\text{MgBr}_2 \cdot 4\text{CO}(\text{NH}_2)_2$
110	80	"	160	67.2	"
115	84.1	"	165	71.4	"
120	90	"	170	83.7	"
123	100	"	171	96	"

* Eutec.

† tr. pt.

MAGNESIUM BROMATE $\text{Mg}(\text{BrO}_3)_2 \cdot 6\text{H}_2\text{O}$.

100 cc. sat. solution contain 42 grams $\text{Mg}(\text{BrO}_3)_2$, or 0.15 gram mols. at 18°.

(Kohlrausch — Sitzb. K. Akad. Wiss. (Berlin), i, 90, '97.)

MAGNESIUM FORMATE $\text{Mg}(\text{HCOO})_2 \cdot 2\text{H}_2\text{O}$.

SOLUBILITY OF MAGNESIUM FORMATE IN WATER.
(Ashton, Houston, and Saylor, 1933.)

t°	Gms. $\text{Mg}(\text{HCOO})_2$ per 100 gms. H_2O	Solid Phase	t°	Gms. $\text{Mg}(\text{HCOO})_2$ per 100 gms. H_2O	Solid Phase
-5.05 Eutec.	14.0	$\text{Ice} + \text{Mg}(\text{HCOO})_2 \cdot 2\text{H}_2\text{O}$	50	16.8	$\text{Mg}(\text{HCOO})_2 \cdot 2\text{H}_2\text{O}$
0	14.0	$\text{Mg}(\text{HCOO})_2 \cdot 2\text{H}_2\text{O}$	60	18.0	"
10	14.1	"	70	19.2	"
20	14.4	"	80	20.6	"
30	15.0	"	90	22.2	"
40	15.9	"	100	24.0	"

SOLUBILITY OF MAGNESIUM FORMATE IN AQUEOUS SOLUTIONS
OF FORMIC ACID AT 25° .
(Dunn and Philip, 1934.)

Gms. per 100 gms. sat. sol. HCOOH	Gms. per 100 gms. sat. sol. $\text{Mg}(\text{HCOO})_2$	Solid Phase	Gms. per 100 gms. sat. sol. HCOOH	Gms. per 100 gms. sat. sol. $\text{Mg}(\text{HCOO})_2$	Solid Phase
0.00	12.23	$\text{Mg}(\text{HCOO})_2 \cdot 2\text{H}_2\text{O}$	60.9	4.68	$\text{Mg}(\text{HCOO})_2 \cdot 2\text{H}_2\text{O}$
15.73	10.10	"	76.2	3.14	"
31.28	8.01	"	90.8	2.15	"
46.7	6.22	"			

CH

MAGNESIUM METHANOLATE $\text{Mg}(\text{CH}_3\text{O})_2 \cdot 2\text{CH}_3\text{OH}$.

SOLUBILITY OF MAGNESIUM METHANOLATE IN METHYL ALCOHOL.
(Quinet, 1935.)

t°	Gms. Mols. $\text{Mg}(\text{CH}_3\text{O})_2$ per 100 gms. sat. solution	Solid Phase
-20	0.074	$\text{Mg}(\text{CH}_3\text{O})_2 \cdot 4\text{CH}_3\text{OH}$
+20	0.118	$\text{Mg}(\text{CH}_3\text{O})_2 \cdot 2\text{CH}_3\text{OH}$
66	0.079	(decomposition begins)

MAGNESIUM ACETATE $\text{Mg}(\text{CH}_3\text{COO})_2 \cdot 4\text{H}_2\text{O}$.

SOLUBILITY OF MAGNESIUM ACETATE IN WATER. (Rivett, 1926.)

t°	Gms. $\text{Mg}(\text{CH}_3\text{COO})_2$ per 100 gms. sat. sol.	Solid Phase	t°	Gms. $\text{Mg}(\text{CH}_3\text{COO})_2$ per 100 gms. sat. sol.	Solid Phase
-0.364..	1.068	Ice	+0.1...	36.2	$\text{Mg}(\text{CH}_3\text{COO})_2 \cdot 4\text{H}_2\text{O}$
-0.531..	1.804	"	14.9...	37.97	"
-1.083..	3.08	"	24.9...	39.61	"
-2.179..	5.92	"	35.0...	41.78	"
-4.687..	11.45	"	45.0...	44.76	"
-9.99...	19.81	"	55.0...	49.46	"
-15.28...	25.00	"	66.0...	66.4 approx. m. pt. of	"
-29.0....	34.5	$+ \text{Mg}(\text{CH}_3\text{COO})_2 \cdot 4\text{H}_2\text{O}$			

MAGNESIUM ACETATE $\text{Mg}(\text{CH}_3\text{COO})_2 \cdot 4\text{H}_2\text{O}$.EQUILIBRIUM IN THE SYSTEM MAGNESIUM OXIDE-ACETIC ACID-WATER AT 25°.
(Iwaki, 1914.)

Gms. per 100 Gms. Sat. Sol.		Solid Phase.	Gms. per 100 Gms. Sat. Sol.		Solid Phase.
CH_3COOH .	MgO .		CH_3COOH .	MgO .	
3.36	1.73	MgO	31.37	7.99	$(\text{CH}_3\text{COO})_2\text{Mg} \cdot 4\text{H}_2\text{O}$
5.65	2.93	"	36.23	8.18	"
8.06	4.21	"	35.77	8.17	"
12.46	6.54	"	40.87	7.42	2.3.3
15.46	8.24	" + $(\text{CH}_3\text{COO})_2\text{Mg} \cdot 4\text{H}_2\text{O}$	47.86	6.74	"
15.38	8.31	$(\text{CH}_3\text{COO})_2\text{Mg} \cdot 4\text{H}_2\text{O}$	56.16	5.81	"
14.25	7.24	"	61.59	4.68	"
20.19	7.47	"	69.13	3.75	"
22.93	7.60	"	75.93	2.85	"
26.61	7.74	"	82.90	2.23	"

2.3.3 = $2(\text{CH}_3\text{COO})_2\text{Mg} \cdot 3\text{CH}_3\text{COOH} \cdot 3\text{H}_2\text{O}$. More careful work in the region of the double salt showed that a second double salt of the composition $5(\text{CH}_3\text{COO})_2\text{Mg} \cdot 10\text{CH}_3\text{COOH} \cdot 7\text{H}_2\text{O}$ was obtained. This compound usually separated from the more concentrated acetic acid solutions.

CH

100 gms. Methyl Alcohol sat. with anhydrous magnesium acetate dissolve 5.25 gm. $\text{Mg}(\text{CH}_3\text{COO})_2$ at 15° and 7.50 gm. at 68.20° (b.pt.). (Henstock, 1934.)

MAGNESIUM TARTRATE $\text{Mg}(\text{C}_4\text{H}_4\text{O}_6) \cdot 2\frac{1}{2} \text{H}_2\text{O}$.

100 cc. of sat. solution of $\text{Mg}(\text{C}_4\text{H}_4\text{O}_6) \cdot 2\frac{1}{2} \text{H}_2\text{O}$ in water contain 0.76 gm. $\text{Mg}(\text{C}_4\text{H}_4\text{O}_6)$ at 30° and 1.44 gm. at 90°. (Chatterjee and Dhar, 1924.)

SOLUBILITY OF ACTIVE MAGNESIUM TARTRATE AND OF RACEMIC MAGNESIUM TARTRATE IN WATER AT SEVERAL TEMPERATURES.
(Duboux and Cuttat, 1921.)

Results for the Active Salt.

t°.	Gms. $\text{MgC}_4\text{H}_4\text{O}_6$ per 100 gms. sat. sol.	Solid Phase.
0.....	0.540	$\text{MgC}_4\text{H}_4\text{O}_6 \cdot 4\text{H}_2\text{O}$
12.5....	0.848	"
25.....	1.174	"
26.2....	1.220	" + $\text{MgC}_4\text{H}_4\text{O}_6 \cdot 2\text{H}_2\text{O}$
37.5....	1.050	$\text{MgC}_4\text{H}_4\text{O}_6 \cdot 2\text{H}_2\text{O}$

Results for the Racemic Salt.

t°.	Gms. $\text{Mg}_2\text{C}_4\text{H}_4\text{O}_{11}$ per 100 gms. sat. sol.	Solid Phase.
0.....	0.403	$\text{Mg}_2\text{C}_4\text{H}_4\text{O}_{11} \cdot 10\text{H}_2\text{O}$
12.5....	0.582	"
25.0....	0.826	"
37.5....	1.095	"

MAGNESIUM SUCCINATE $\text{C}_4\text{H}_4\text{O}_4\text{Mg} \cdot 5\text{H}_2\text{O}$.

100 gms. sat. solution in water contain 24.35 gms. succinate at 15° and 66.36 gms. at 100°. (Tarugi and Checchi, 1902.)

MAGNESIUM MALATE active, $\text{C}_4\text{H}_4\text{O}_5\text{Mg} \cdot 3\text{H}_2\text{O}$; racemic, $\text{C}_4\text{H}_4\text{O}_5\text{Mg}_2 \cdot 5\text{H}_2\text{O}$.

SOLUBILITY OF EACH FORM IN WATER.

(Duboux and Cuttat, 1921.)

Active Salt.

t°.	Gms. $\text{C}_4\text{H}_4\text{O}_5\text{Mg}$ per 100 gms. sat. sol.	Solid Phase.
0.....	2.02	$\text{C}_4\text{H}_4\text{O}_5\text{Mg} \cdot 3\text{H}_2\text{O}$
12.5.....	2.28	"
25.0.....	2.54	"
37.5.....	2.80	"

Racemic Salt.

t°.	Gms. $\text{C}_4\text{H}_4\text{O}_5\text{Mg}_2$ per 100 gms sat. sol.	Solid Phase.
0.....	0.93	$\text{C}_4\text{H}_4\text{O}_5\text{Mg}_2 \cdot 5\text{H}_2\text{O}$
12.5.....	1.08	"
25.0.....	1.23	"
37.5.....	1.38	"

Saturation was obtained by continuous rotation for 7 to 10 hours.

MAGNESIUM LACTATE $\text{Mg}(\text{C}_3\text{H}_5\text{O}_2)_2 \cdot 3\text{H}_2\text{O}$.

100 gms. Methyl Alcohol sat. with anhydrous magnesium lactate dissolve 2.27 gms. $(\text{C}_3\text{H}_5\text{O}_2)_2$ at 15° and 1.14 gms. at 66.1° (b.pt.). (Henstock 1934.)

MAGNESIUM DiLACTATE $\text{Mg}(\text{C}_4\text{H}_7\text{O}_4)_2 \cdot 6\text{H}_2\text{O}$ racemic, $\text{Mg}(\text{C}_4\text{H}_7\text{O}_4)_2 \cdot 3\text{H}_2\text{O}$, inactive.

SOLUBILITY OF RACEMIC AND OF INACTIVE MAGNESIUM DiLACTATE IN WATER.
(Jungfleisch, 1912.)

100 gms. H_2O dissolve 7 to 8 gms. racemic and 2.28 gms. inactive lactate at 15° .

MAGNESIUM GLUCONATE $\text{Mg}(\text{C}_6\text{H}_{11}\text{O}_7)_2 \cdot 3\text{H}_2\text{O}$.

100 gms. sat. solution of $\text{Mg}(\text{C}_6\text{H}_{11}\text{O}_7)_2 \cdot 3\text{H}_2\text{O}$ in Water contain 7.8 gms. $(\text{C}_6\text{H}_{11}\text{O}_7)_2$ at 25° . (May, Weisberg and Herrick, 1929.)

MAGNESIUM BENZOATE $\text{Mg}(\text{C}_6\text{H}_5\text{COO})_2 \cdot 4\text{H}_2\text{O}$.

100 gms. H_2O dissolve 6.16 gms. $\text{Mg}(\text{C}_6\text{H}_5\text{COO})_2$ at 15° and 19.6 gms. at 100° .
(Tarugi and Checchi, 1901.)

100 gms. H_2O dissolve 3.33 gms. $\text{Mg}(\text{C}_6\text{H}_5\text{COO})_2$ at $15-20^\circ$. (Squire and Caines, 1905.)

CH

100 gms. Acetone sat. with anhydrous Mg benzoate dissolve 2.38 gm. $(\text{C}_6\text{H}_5\text{COO})_2$ at 15° . (Henstock, 1934.)

MAGNESIUM BENZOATE $\text{Mg}(\text{C}_6\text{H}_5\text{COO})_2 \cdot 4\text{H}_2\text{O}$.

MAGNESIUM 4-Nitro BENZOATE $\text{Mg}(\text{C}_6\text{H}_4\text{NO}_2\text{COO})_2 \cdot 6\text{H}_2\text{O}$.

cc. sat. solution of Magnesium benzoate in water }
contain 6.364 gms. $\text{Mg}(\text{C}_6\text{H}_5\text{COO})_2$ at 20° . }
cc. sat. solution of Magnesium 4-Nitro benzoate in } (Ephraim and Pfister, 1925.)
water contain 1.840 gms. $\text{Mg}(\text{C}_6\text{H}_4\text{NO}_2\text{COO})_2$ at 20° . }

MAGNESIUM BENZOATE Tri Methyl Alcoholate $\text{Mg}(\text{C}_6\text{H}_5\text{COO})_2 \cdot 3\text{CH}_3\text{OH}$

100 gms. Methyl Alcohol sat. with the tri alcoholate dissolve 1.24 gms. $\text{Mg}(\text{C}_6\text{H}_5\text{COO})_2$ at 15° and 70.98 gms. at 71.9° (b.pt.). (Henstock, 1934.)

MAGNESIUM SALICYLATE $\text{Mg}(\text{C}_7\text{H}_5\text{O}_3)_2 \cdot 4\text{H}_2\text{O}$.

100 gms. sat. solution in water contain 20.4 gms. salicylate at 15° (14.3 gms. Squire and Caines, 1905), and 79.7 gms. at 100° . (Tarugi and Checchi, 1901.)

100 gms. 90% alcohol dissolve 0.6 gm. salicylate at $15^\circ-20^\circ$. (Squire and Caines, 1905.)

Mg MAGNESIUM

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MAGNESIUM PHTHALATE $2\text{Mg C}_6\text{H}_4(\text{COO})_2 \cdot 11\text{H}_2\text{O}$.

SOLUBILITY OF MAGNESIUM PHTHALATE IN AQUEOUS SOLUTIONS OF PHTHALIC ACID.

(Smith and Ely, 1941.)

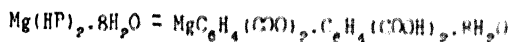
Gms. per 100 gms. sat. sol.		Solid Phase
$\text{C}_6\text{H}_4(\text{COOH})_2$	$\text{Mg C}_6\text{H}_4(\text{COO})_2$	
Results at 0°		
0.0	30.63	$2\text{MgC}_6\text{H}_4(\text{COO})_2 \cdot 11\text{H}_2\text{O}$
0.39	30.78	" + $\text{Mg}(\text{HP})_2 \cdot 8\text{H}_2\text{O}$
0.47	26.58	$\text{Mg}(\text{HP})_2 \cdot 8\text{H}_2\text{O}$
0.76	16.20	"
1.06	7.69	"
1.58	1.95	" + $\text{C}_6\text{H}_4(\text{COOH})_2$
1.00	0.99	$\text{C}_6\text{H}_4(\text{COOH})_2$
0.29	0.0	"

Results at 25°

0.0	34.11	$2\text{MgC}_6\text{H}_4(\text{COO})_2 \cdot 11\text{H}_2\text{O}$
0.47	34.16	"
1.03	34.26	"
1.16	34.40	" + $\text{Mg}(\text{HP})_2 \cdot 8\text{H}_2\text{O}$
1.21	32.26	$\text{Mg}(\text{HP})_2 \cdot 8\text{H}_2\text{O}$
1.30	30.98	"
1.36	27.49	"
1.54	23.49	"
1.60	22.75	"
1.72	20.46	"
1.79	19.17	"
2.33	8.92	"
3.23	4.71	"
3.61	4.16	" + $\text{C}_6\text{H}_4(\text{COOH})_2$
2.70	2.66	$\text{C}_6\text{H}_4(\text{COOH})_2$
1.69	1.27	"
0.69	0.0	"

Results at 50°

0.0	42.28	$2\text{MgC}_6\text{H}_4(\text{COO})_2 \cdot 11\text{H}_2\text{O}$
3.12	42.71	"
3.53	42.80	" + $\text{Mg}(\text{HP})_2 \cdot 8\text{H}_2\text{O}$
3.67	41.19	$\text{Mg}(\text{HP})_2 \cdot 8\text{H}_2\text{O}$
3.88	38.35	"
4.64	31.51	"
5.52	24.20	"
6.56	18.72	"
7.95	13.68	"
10.21	11.19	" + $\text{C}_6\text{H}_4(\text{COOH})_2$
9.47	9.95	$\text{C}_6\text{H}_4(\text{COOH})_2$
7.43	6.95	"
6.15	5.36	"
4.13	2.85	"
1.72	0.0	"



MAGNESIUM MANDELATE (r), (l), $\text{Mg}(\text{C}_6\text{H}_5\text{CH}(\text{OH})\text{COO})_2$

SOLUBILITY OF MAGNESIUM MANDELATES IN WATER.

(Findlay and Campbell, 1930.)

t°	Gms. $\text{Mg}(\text{C}_6\text{H}_5\text{CH}(\text{OH})\text{COO})_2$ per 100 gms. H_2O		Solid Phase in solutions sat. with racemic salt	Results (1) for Solutions in equilibrium with Solid Phases composed of both active and racemic Salt.	t°	Gms. per 100 gms. H_2O	
	Results for r-Salt	Results for l-Salt				l Salt	d Salt
0	1.52	1.60	$\text{Mg}(\text{Man})_2 \cdot \text{H}_2\text{O}$		0	1.94	0.24
5	1.36	1.68	"		5	2.12	0.55
10	1.15	0.72	"		10	1.59	0.32
15	1.06	1.77	$\text{Mg}(\text{Man})_2 \cdot \frac{1}{2}\text{H}_2\text{O}$		15	2.66	0.60
20	1.04	1.83	"		20	2.23	0.39
25	0.95(2.61)	1.97(6.08)	"		25	1.96	0.41
30	0.88	2.11	$\text{Mg}(\text{Man})_2$		30	2.16	0.49
35	1.16	2.72	"		35	2.40	0.49
40	1.33	5.07	"		40	2.50	0.50

Man = $\text{C}_6\text{H}_5\text{CH}(\text{OH})\text{COO}$

(1) Determined polarimetrically

Other values for the solubility of the (r) and (l) salts in water are follows.

CH

t°	Gms. $\text{Mg}(\text{C}_6\text{H}_5\text{CH}(\text{OH})\text{COO})_2$ per 100 gms. sat. sol.		Authority
	(r) Salt	(l) Salt	
16	—	4.5	McKenzie, 1899.
18	1.8	—	" "
25	2.61	—	Ross and Morrison, 1936.
25	—	6.08	" " " and Johnstone, 1937.

Ross and Morrison, 1936 also give results for the system Magnesium (r) Mandelate + (r) Mandelic Acid + H_2O at 25° in which the acid salt, $(\text{C}_6\text{H}_7\text{O}_3)_2\text{C}_6\text{H}_7\text{O}_3 \cdot 2\text{H}_2\text{O}$ is formed.

Ross, Morrison and Johnston, 1937, give results for the system Magnesium Mandelate + (l) Mandelic Acid + H_2O at 25° in which the acid salt which is formed probably has the same composition as that of the (r) compound but, due to analytical difficulties, metastability and slowness with which equilibrium is attained, conclusive results were not obtained.

MAGNESIUM CINNAMATE $\text{Mg}(\text{C}_6\text{H}_5\text{CH}(\text{CHCOO}))_2 \cdot 1$ or $4 \text{H}_2\text{O} (?)$.

SOLUBILITY OF MAGNESIUM CINNAMATE IN WATER.

t°	Gms. $\text{Mg}(\text{C}_6\text{H}_5\text{CH}(\text{CHCOO}))_2$ per 100 cc sat. solution	Authority
15	0.85°	(Tarugi and Checchi, 1901.)
18	1.114	(Fredholm, 1934.)
20	1.225	(Ephraim and Pfister.)
30	1.94°	(Tarugi and Checchi, 1901.)

° per 100 gms. sat. solution.

**SOLUBILITY OF MAGNESIUM CINNAMATE IN AQUEOUS SOLUTIONS
OF AMMONIUM CHLORIDE AND AMMONIA AT 18°.**

(Fredholm, 1934.)

Comp. of Aq. solvent in Gm. Equiv. per liter	Gm. Equiv. Mg per liter sat. sol.	Comp. of Aq. solvent in Gm. Equiv. per liter	Gm. Equiv. Mg per liter sat. sol.
Water alone	0.07	0.2994 NH ₄ Cl + 0.5988 NH ₃	0.0957
0.2994 NH ₄ Cl	0.0847	0.2994 " + 0.798 "	0.0981
0.2994 " + 0.1996 NH ₃	0.0889	0.2994 " + 1.000 "	0.1004
0.2994 " + 0.3992 "	0.0928		

MAGNESIUM CAMPHORATE C₁₀H₁₄O₄Mg.14H₂O.

**SOLUBILITY OF MAGNESIUM CAMPHORATE IN *d* CAMPHORIC ACID AT 15°
AND VICE VERSA.**

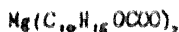
(Jungfleisch and Landrieu, 1914.)

Gms. per 100 Gms. Sat. Sol.	Solid Phase.	Gms. per 100 Gms. Sat. Sol.	Solid Phase.
C ₁₀ H ₁₆ O ₄	C ₁₀ H ₁₄ O ₄ Mg.	C ₁₀ H ₁₆ O ₄	C ₁₀ H ₁₄ O ₄ Mg.
0.622 (13.5°)	0	3.16	10.30
1.20	1.29	3.5	16.5
1.98	3.53	3.6	16.7
2.36	5.66	1.91	15.1
2.85	8.19	0	14.25

C₁₀H₁₄O₄
+ C₁₀H₁₄O₄Mg.14H₂O
C₁₀H₁₄O₄Mg.14H₂O
"

CH

MAGNESIUM CAMPHOR CARBONATE



SOLUBILITY OF MAGNESIUM CAMPHOR CARBONATE IN ALCOHOLS.

(Picon, 1931.)

Solvent	Formula	t°	Gms. Mg(C ₁₀ H ₁₅ OCCOO) ₂ per liter sat. sol.
Methyl Alcohol	CH ₃ OH	10.5	10.5
Ethyl Alcohol	C ₂ H ₅ OH	9	0.36

MAGNESIUM Alkyl SULFONATES

SOLUBILITY OF EACH SEPARATELY IN WATER.

(Reed and Tartar, 1936.)

Compound	Formula	Gms. Compound per 100 gms. H ₂ O at:	
		25°	50°
Magnesium <i>n</i> Decyl Sulfonate	Mg(CH ₂ (CH ₂) ₉ CH ₂ SO ₃) ₂	0.268	—
" Lauryl	Mg(CH ₂ (CH ₂) ₁₀ CH ₂ SO ₃) ₂	0.033	48.0
" Myristyl	Mg(CH ₂ (CH ₂) ₁₂ CH ₂ SO ₃) ₂	0.0015	0.016
" Cetyl	Mg(CH ₂ (CH ₂) ₁₄ CH ₂ SO ₃) ₂	0.0012	0.006
" <i>n</i> Octadecyl	Mg(CH ₂ (CH ₂) ₁₆ CH ₂ SO ₃) ₂	0.0010	0.003

MAGNESIUM Anthracene, Benzene and Naphthalene SULFONATES.**SOLUBILITY OF EACH IN WATER.**

(Ephraim and Pfister, 1925, 1925 a; Ephraim and Jeger, 1925.)

Compound.	Formula.	t°.	Gms. anhydrous compd. per 100 cc. sat. sol.
Magnesium Anthracene-1-sulfonate...	$Mg(C_{14}H_9SO_3)_2 \cdot 4H_2O$	20....	0.0799
» » -2- » ..	$Mg(C_{14}H_9SO_3)_2 \cdot 4H_2O$	20....	0.0077
» Benzene sulfonate.....	$Mg(C_6H_5SO_3)_2 \cdot 6H_2O$	17....	7.496
» » »	»	20....	7.639
» » »	»	36....	11.153
» » »	»	50....	14.569
» » »	»	65....	20.420
» » »	»	80.5..	26.045
» » »	»	82.0..	26.804
» Naphthalene-1-sulfonate..	$Mg(C_{10}H_7SO_3)_2 \cdot 6H_2O$	17....	6.978
» » -2- » ..	$Mg(C_{10}H_7SO_3)_2 \cdot 4H_2O$	16.5..	0.2
» » -2- » ..	$Mg(C_{10}H_7SO_3)_2 \cdot 6H_2O$	20.0..	0.223
» » » ..	»	32	0.373
» » » ..	»	45	0.490
» » » ..	»	59	0.790
» » » ..	»	74	1.336
» » » ..	»	82	1.737
» -6 oxy-2-sulfonate..	$Mg(C_{10}H_7SO_3)_2 \cdot 8H_2O$	20	0.964

Results for the solubility of Magnesium Benzene Sulfonate aqueous solutions of Benzene Sulfonic Acid at 25°, are given by Dunn and Philip, 1934.

CH

SOLUBILITY OF MAGNESIUM NAPHTHALENE -2- SULFONATE IN AQUEOUS SOLUTIONS OF AMMONIUM CHLORIDE AND AMMONIA AT 18°.

(Fredholm, 1934.)

Composition of Aq. Solvent in Gm. Equiv. per liter	Gm. Equiv. Mg per liter sat. sol.	Composition of Aq. Solvent in Gm. Equiv. per liter	Gm. Equiv. Mg per liter sat. sol.
Water alone	0.010	0.1984 NH_4Cl + 0.784 NH_3	0.0170
0.1984 NH_4Cl	0.014	" " + 1.000 "	0.0175
" " + 0.196 NH_3	0.0151	0.2976 " "	0.0150
" " + 0.392 "	0.0155	" " + 0.392 "	0.0166
" " + 0.588 "	0.0161	" " + 1.000 "	0.0191

MAGNESIUM Naphthylamine Di SULFONATES $MgC_{10}H_5(NH_2)(SO_3)_2$, 2.6.8 and 2.5.7.

0 gms. sat. sol. of the 2.6.8 compd. in water contain 8.7 gms. }
 $MgC_{10}H_5(NH_2)(SO_3)_2$ at 15°. } (Braunschweig,
 0 gms. sat. sol. of the 2.5.7 compd. in water contain 21.09 gms. } 1922, 1926.)
 $MgC_{10}H_5(NH_2)(SO_3)_2$ at 15°.

One liter water sat. with Magnesium-1-Naphthylamine 2-4-7 Tri Sulfonate contains 193 gms. $MgC_{10}H_4NH_2(SO_3)_3H$ at 20° and 235 gms. at 80°.

(Frisch, 1930.)

Mg MAGNESIUM

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MAGNESIUM Anthraquinone SULFONATES

SOLUBILITY OF EACH SEPARATELY IN WATER.
(Fierz-David, Krebaen and Anderau, 1927.)

Compound	Formula	t°	Gms. anhydrous (?) Compound per 100 cc H ₂ O
Magnesium Anthraquinone: 2- Sulfonate	$\text{MgC}_{14}\text{H}_7\text{O}_2\text{SO}_3 \cdot 2\text{H}_2\text{O}$	18	0.36
1.5 Disulfonate	$\text{MgC}_{14}\text{H}_6\text{O}_2(\text{SO}_3)_2 \cdot 8\text{H}_2\text{O}$	100	1.03
"	"	18	2.04
1.8 "	$\text{MgC}_{14}\text{H}_6\text{O}_2(\text{SO}_3)_2 \cdot 6\text{H}_2\text{O}$	100	18.2
"	"	18	1.0
1.6 "	$\text{MgC}_{14}\text{H}_6\text{O}_2(\text{SO}_3)_2 \cdot 8\text{H}_2\text{O}$	100	7.1
"	"	18	14.3
1.7 "	$\text{MgC}_{14}\text{H}_6\text{O}_2(\text{SO}_3)_2 \cdot 10\text{H}_2\text{O}$	100	40.0
"	"	18	33.3
2.6 "	$\text{MgC}_{14}\text{H}_6\text{O}_2(\text{SO}_3)_2 \cdot 3\text{H}_2\text{O}$	100	100.0
2.7 "	$\text{MgC}_{14}\text{H}_6\text{O}_2(\text{SO}_3)_2 \cdot 5\text{H}_2\text{O}$	18	2.53
1.5 Chlorosulfonate	$\text{MgC}_{14}\text{H}_6\text{O}_2\text{ClSO}_3 \cdot 8\text{H}_2\text{O}$	18	41.0
		18	0.34

MAGNESIUM Phenanthrene SULFONATES

SOLUBILITY OF EACH SEPARATELY IN WATER.
(Sandsquist, 1912.)

CH

Compound	Gms. anhydrous Salt per 100 gms. H ₂ O
Magnesium Phenanthrene -2- Mono Sulfate	0.051
" " -3- " "	0.116
" " -10- " "	0.220

MAGNESIUM o and p Xylol SELENATES.

SOLUBILITY OF EACH IN WATER.
(Anschütz, Kallen and Hoppenkröger, 1919.)

Compound.	Formula.	t°	Gms. anhydrous cm per 100 gms. H ₂ O
Ortho compound...	$[\text{C}_6\text{H}_3(\text{CH}_3)_2(1.2)\text{SeO}_3(4)]_2\text{Mg}$	20	0.85
Para " ...	$[\text{C}_6\text{H}_3(\text{CH}_3)_2(1.4)\text{SeO}_3]_2\text{Mg} \cdot 8\text{H}_2\text{O}$	15	2.02

MAGNESIUM HYDNOCARPATE $\text{Mg} \left(\begin{array}{c} \text{CH} = \text{CH} \\ | \quad | \\ \text{CH}_2 - \text{CH}_2 \end{array} > \text{CH}(\text{CH}_2)_{10}\text{COO} \right)_2$

MAGNESIUM CHAULMOGRATE $\text{Mg} \left(\begin{array}{c} \text{CH} = \text{CH} \\ | \quad | \\ \text{CH}_2 - \text{CH}_2 \end{array} > \text{CH}(\text{CH}_2)_{12}\text{COO} \right)_2$

SOLUBILITY OF EACH SEPARATELY IN SEVERAL SOLVENTS.
(Cole, 1932.)

Solvent	t°	Gms. Mg Hydno carpate per 100 cc sat. solution	Gms. Mg Chaulmoograte per 100 cc sat. solution
95% Ethyl Alcohol	15	0.51	0.37
" " "	30	0.67	0.44
" " "	b. pt.	0.56	0.46
Ethyl Ether	15	0.04	0.02
" " "	30	0.045	0.036
" " "	b. pt.	0.036	0.024
Benzene	15	0.02	0.01
" " "	30	0.04	0.004
" " "	b. pt.	21.42	22.27
Petroleum Ether			

MAGNESIUM ERUCATE $C_8H_{17}CH:CH(CH_2)_{11}COOMg$.

SOLUBILITY OF MAGNESIUM ERUCATE IN AQUEOUS ETHYL ALCOHOL
AT 25°. (Thomas and Matlikow, 1926.)

Wt. per cent C_2H_5OH .	d_{25}^4 of	Gms. $C_8H_{17}CH:CH(CH_2)_{11}COOMg$ per	
	Sat. sol.	100 cc. sat. sol.	100 gms. solvent
0.0 (= H_2O).....	—	0.006	0.006
18.13.....	0.9690	0.007	0.005
28.37.....	0.9535	0.007	0.008
45.67.....	0.9194	0.019	0.020
65.82.....	0.8734	0.142	0.171
75.40.....	0.8504	0.179	0.240
88.38.....	0.8177	0.268	0.349
94.28.....	0.8018	0.323	0.420

MAGNESIUM HELIANTHATE $Mg(C_{14}H_{13}N_3SO_3)_2 \cdot 4H_2O$.

100 cc. H_2O dissolve 0.035 gm. magnesium helianthate at 20-25°.

(Stark and Dehn, 1918.)

MAGNESIUM LIGNOCERATE.

100 gms. H_2O dissolve 0.002 gm. magnesium lignocerate at 25°.

100 gms. 44.13 per cent aq. alcohol dissolve 0.003 gm., and 100 gm. 91.53 per cent alcohol dissolve 0.006 gm.

(Thomas and Yu, 1923.)

MAGNESIUM OLEATE $(CH_3(CH_2)_{13}CH:CH.CH_2COO)_2Mg$.

CH

One liter H_2O dissolves about 0.23 gm. oleate (soap).

(Fahrian, 1916.)

100 gms. glycerol (d 1.114) dissolve 0.94 gm. oleate.

(Asselin, 1873.)

MAGNESIUM OLEATE $(C_{17}H_{33}COO)_2Mg$.

Solutions prepared by rubbing magnesium oleate (prepared from technical sodium oleate) with water or salt solution and allowing to stand at room temperature for 36 hours, contained from 4.28 to 5.42 milligrams Mg per liter of water and 5.85 to 5.77 milligrams Mg per liter of 0.05 or 0.1 per cent aqueous Na Cl solution.

(Zink and Liere, 1915.)

Solutions prepared by heating a suspension of magnesium oleate in water or aqueous salt solution to the boiling point and allowing to cool, contained 50.6 parts Mg per liter of water, 99.89 parts Mg per liter of 0.1 per cent aq. Na Cl and 90.26 parts Mg per liter of 0.1 per cent aq. K Cl solution.

(Haupt, 1914.)

100 gms. 63.07 wt. % aq. alcohol dissolve 4.60 gms. $(C_{17}H_{33}COO)_2Mg$ at 25°

" 72.17 " " " 6.64 " "

" 86.16 " " " 8.60 " "

(Thomas and Yu, 1923.)

MAGNESIUM PALMITATE $(C_{16}H_{31}COO)_2Mg$.

Solutions prepared by rubbing magnesium palmitate (prepared from pure sodium palmitate) with water or aqueous salt solution and allowing to stand at room temperature for 36 hours contained from 2.82 to 3.03 milligrams Mg per liter of water and 3.12 to 3.03 milligrams Mg per liter of 0.05 to 0.10 per cent aqueous Na Cl solution.

(Zink and Liere, 1915.)

Solutions prepared by heating a suspension of magnesium palmitate in water or aqueous salt solution to the boiling point and allowing to cool, contained 55.68 parts Mg per liter of water, 92.21 parts Mg per liter of 0.1 per cent aq. Na Cl and 72.39 parts Mg per liter of 0.1 per cent aq. K Cl.

(Haupt, 1914.)

MAGNESIUM STEARATE ($C_{17}H_{35}COO$)₂ Mg.

Solutions prepared by rubbing magnesium stearate (prepared from commercial sodium stearate) with water or salt solutions and allowed to stand at room temperature for 36 hours contained from 3.17 to 3.23 milligrams Mg per liter of water and 3.70 to 3.84 milligrams Mg per liter of 0.05 to 0.1 % aq. Na Cl. solution.

(Zink and Liere, 1915.)

Solutions prepared by heating a suspension of magnesium stearate in water or aqueous salt solution to the boiling point and allowing to cool, contained 65.89 parts Mg per liter of H_2O , 95.79 parts Mg per liter of 0.1 % aq. Na Cl solution and 99.62 parts Mg per liter of 0.1 % aq. K Cl solution.

(Haupt, 1914.)

SOLUBILITY OF MAGNESIUM STEARATE IN AQUEOUS SOLUTIONS OF ETHYL ALCOHOL AT 25°. (Thomas and Yu, 1923.)

Constant agitation was employed for obtaining saturation.

Wt. per cent C_2H_5OH in solvent.	d_{25} of sat. sol.	Gms. $C_{17}H_{35}COO$ $\frac{1}{2}$ Mg per	
		100 cc sat. sol.	100 gms. solvent.
0.0 ($= H_2O$).....	0.99709	0.001	0.004
19.9.....	0.97122	0.004	0.004
27.29.....	0.95792	0.003	0.003
44.13.....	0.92275	0.003	0.003
63.07.....	0.87783	0.004	0.005
72.17.....	0.85821	0.005	0.006
86.16.....	0.82356	0.006	0.007
91.53.....	0.80935	0.006	0.007

CH

MAGNESIUM LAURATE, MYRISTATE, PALMITATE and STEARATE.

SOLUBILITY OF EACH IN SEVERAL SOLVENTS. (Jacobson and Holmes, 1916.)

Gms. Each Salt Determined Separately per 100 Gms. Solvent.

Solvent.	°.	Mg Laurate ($C_{12}H_{25}COO$) ₂ Mg	Mg Myristate ($C_{14}H_{27}COO$) ₂ Mg	Mg Palmitate ($C_{16}H_{33}COO$) ₂ Mg.	Mg Stearate ($C_{18}H_{37}COO$) ₂ Mg.
Water	15	0.010	0.006	0.005	0.003
"	25	0.007	0.006	0.008	0.004
"	35	0.010	0.007	0.006	0.007
"	50	0.026	0.014	0.009	0.008
Abs. Ethyl Alcohol	15	0.519	0.158	0.034	0.017
"	25	0.591	0.236	0.058	0.023
"	35	0.805	0.373	0.085	0.031
"	50	1.267	0.577	0.151	...
Methyl Alcohol	15	1.095	0.571	0.227	0.084
"	25	1.108	0.763	0.36	0.100
"	51.5	...	...	0.50	0.166
Ether	25	0.015	0.010	0.004	0.003
Ethyl Acetate	15	0.004	0.004	0.004	0.004
"	35	0.011	0.010	0.007	0.008
"	50	0.024	0.021	0.013	...
Amyl alcohol	15	0.191	0.086	0.043	0.014
"	25	0.236	0.145	0.066	0.018
"	35	1.481	0.438	0.104	0.039
"	50	4.869	1.893	0.263	0.105
Amyl Acetate	15	0.119	0.063	0.039	0.029
"	25	0.162	0.073	0.045	0.030
"	34.6	0.259	0.105	0.057	0.046
"	50	1.939	0.605	0.216	0.115

MAGNESIUM PLATINIC CYANIDE MgPt(CN)_4 **SOLUBILITY IN WATER.**

(Buxhoeveden and Tamman — Z. anorg. Ch. 15, 319 '97.)

t°.	Gms. MgPt(CN)_4 per 100 Gms. Solution.	Solid Phase.	t°.	Gms. MgPt(CN)_4 per 100 Gms. Solution.	Solid Phase.
-4.12	24.90	$\text{MgPt(CN)}_4 \cdot 6.8-8.1 \text{H}_2\text{O}$	48.7	40.89	$\text{MgPt(CN)}_4 \cdot 4 \text{H}_2\text{O}$
0.5	26.9	(Red)	55	41.33	"
5.5	28.65	"	58.1	42.15	"
18.0	32.46	"	69.0	43.40	"
36.6	39.53	"	77.8	44.90	"
45.0	41.33	"	87.4	45.52	"
46.2	42.0	"	90.0	45.65	"
42.2	40.21	$\text{MgPt(CN)}_4 \cdot 4 \text{H}_2\text{O}$	93.0	45.04	"
46.3	39.85	(Bright Green)	96.4	44.33	$\text{MgPt(CN)}_4 \cdot 2 \text{H}_2\text{O}$
			100.0	44.0	(White)

MAGNESIUM FERROCYANIDES.**SOLUBILITY IN WATER AT 17°.**

(Robinson, 1909.)

One liter sat. sol. contains 1.95 gms. magnesium potassium ferrocyanide. $\text{MgK}_3\text{FeC}_6\text{N}_6$.

One liter sat. sol. contains 2.48 gms. magnesium ammonium ferrocyanide. $\text{Mg(NH}_4)_2\text{FeC}_6\text{N}_6$.

MAGNESIUM CARBONATE $\text{MgCO}_3 \cdot 3\text{H}_2\text{O}$.
**SOLUBILITY OF MAGNESIUM CARBONATE IN WATER AT 25°
AND PRESSURES OF CARBON DIOXIDE UP TO ONE ATMOSPHERE.**

(Kline, 1920.)

The saturated solutions were prepared by bubbling mixtures of carbon dioxide and air in constant proportions through conductivity water in contact with finely divided solid for periods of three to five days.

Partial Pressure of CO_2 in Atmospheres	Millimols per 1000 gms. H_2O			Partial Pressure of CO_2 in Atmospheres	Millimols per 1000 gms. H_2O		
	$[\text{Mg}^{++}]$	$[\text{HCO}_3^-]$	$[\text{CO}_2^{--}]$		$[\text{Mg}^{++}]$	$[\text{HCO}_3^-]$	$[\text{CO}_2^{--}]$
0.000107	0.00433	0.004880	0.00189	0.000510	0.01437	0.01710	0.00582
0.000113	0.00445	0.00501	0.00195	0.000680	0.01512	0.01872	0.00576
0.000170	0.00577	0.00745	0.00205	0.000845	0.01566	0.01990	0.00571
0.000179	0.00593	0.00763	0.00212	0.000887	0.01593	0.02046	0.00570
0.000197	0.00658	0.00795	0.00261	0.000930	0.01624	0.02119	0.00565
0.000210	0.00708	0.00806	0.00305	0.00160	0.01859	0.02698	0.00510
0.000233	0.00780	0.00837	0.00361	0.00334	0.02210	0.03548	0.00436
0.000251	0.00807	0.00855	0.00380	0.00690	0.02507	0.04468	0.00271
0.000310	0.01013	0.01184	0.00421	0.0150	0.03127	0.06022	0.00116
0.000376	0.01296	0.01404	0.00594	0.0432	0.04601	0.08998	0.00102
0.000380	0.01355	0.01432	0.00639	0.1116	0.06266	0.1236	0.00085
				0.9684	0.2135	0.4269	—

The activity product constant of magnesium carbonate at 25° is taken as 1×10^{-5} and that of magnesium hydroxide similarly as 5×10^{-12} .

The author also gives the following interpolated values of the molarity of magnesium in aqueous solutions saturated with $\text{MgCO}_3 \cdot 3\text{H}_2\text{O}$ at 25° and at partial pressures of Carbon Dioxide up to 15 atmospheres.

Partial Pressure of CO_2 in Atms.	Millimols (Mg) per 1000 gms. H_2O	Partial Pressure of CO_2 in Atms.	Millimols (Mg) per 1000 gms. H_2O
0.001	0.0178	0.7	0.181
0.01	0.0270	1.0	0.217
0.05	0.0489	2.0	0.287
0.10	0.0660	5.0	0.384
0.3	0.117	10.0	0.471

MAGNESIUM CARBONATE $\text{MgCO}_3 \cdot 3\text{H}_2\text{O}$.

SOLUBILITY OF MAGNESIUM CARBONATE IN WATER CONTAINING INCREASING AMOUNTS OF CARBON DIOXIDE AT 25°. (Mitchell, 1923.)

A silver lined steel bulb was used. The mixture was stirred by a current of CO_2 .

Atmospheres pressure of Carbon Dioxide.	Mols. per liter of sat. solution	
	Total [Mg].	Total [CO_2].
6.....	0.376	0.896
9.....	0.450	1.147
11.....	0.485	1.250
13.....	0.505	1.350
16.....	0.530	1.395
21.....	0.613	1.738

EQUILIBRIUM IN THE SYSTEM MAGNESIUM OXIDE, CARBON DIOXIDE AND WATER.
(Takahaashi, 1927.)

CO

t°	d. of sat. sol.	Gms. per 100 gms. sat. sol.		Solid Phase	t°	d. of sat. sol.	Gms. per 100 gms. sat. sol.		Solid Phase
		CO_2	H_2O				CO_2	H_2O	
-1.80	1.0411	3.410	1.526	$\text{MgCO}_3 \cdot 5\text{H}_2\text{O}$	20	1.0287	2.109	0.9858	$\text{MgCO}_3 \cdot 3\text{H}_2\text{O}$
0	1.0407	3.219	1.496	"	25	1.0250	1.839	0.8654	"
+5	1.0395	2.942	1.423	"	30	1.0210	1.572	0.7634	"
10	1.0383	2.962	1.363	"	35	1.0170	1.381	0.6780	"
15	1.0373	2.744	1.312	"	40	1.0135	1.206	0.6017	"
20	1.0363	2.606	1.256	"	45	1.0097	1.044	0.5323	"
5	1.0407	3.232	1.530	$\text{MgCO}_3 \cdot 3\text{H}_2\text{O}$	50	1.0050	0.922	0.4718	"
10	1.0360	2.736	1.314	"	55	1.0008	0.833	0.4083	"
15	1.0330	2.270	1.143	"	60	0.9980	0.746	0.3648	"

Results are also given for the solubility of $5\text{MgO} \cdot 4\text{CO}_2 \cdot 7\text{H}_2\text{O}$ in water saturated with CO_2 at one atmosphere pressure.

Data for the system $\text{MgO} + \text{MgCl}_2 + \text{H}_2\text{O}$ at 25° and at 50° are given by Magda and Yamane, 1928.

Determinations of the equilibrium in the system $\text{MgCO}_3 + \text{CO}_2 + \text{H}_2\text{O}$ made by passing CO_2 at atmospheric pressure through mixtures of $\text{H}_2\text{O} + \text{MgO}$ and $\text{H}_2\text{O} + \text{Mg}_2\text{CO}_3$ at temperatures from 0° to 40°, are given by Tereda, 1928. There is, however, some uncertainty in regard to the exact terms in which the results are expressed.

SOLUBILITY OF MAGNESIUM CARBONATE IN CO_2 FREE WATER AT 100°.

(Leick, 1932, 1933.)

The determinations showed that 0.030 gm. $\text{MgO} = 0.063$ gm. MgCO_3 per liter was dissolved at 100°. It was found that the solubility is increased by NaCl and Na_2SO_4 . NaOH and Na_2CO_3 do not reduce the solubility of MgCO_3 as much as they do that of CaCO_3 . Results for the simultaneous solubility of MgCO_3 and CaCO_3 in water at 100° show that with increasing time of boiling, from 14 to 48 hours, the dissolved CaO increased about 5 times while the dissolved MgO decreases about 10 times. The results are of interest in connection with the purification of boiler waters.

MAGNESIUM CARBONATE $\text{MgCO}_3 \cdot 3\text{H}_2\text{O}$.SOLUBILITY IN WATER IN PRESENCE OF CARBON DIOXIDE AT 15° .

(Treadwell and Reuter — Z. anorg. Ch. 17, 200, '98.)

cc. CO_2 per 100 cc. Gas Phase (at 0° and 760 mm.).	Partial Pressure of CO_2 in mm. Hg.	Grams per 100 cc. Solution.			
		Free CO_2 .	MgCO_3 .	$\text{Mg}(\text{HCO}_3)_2$.	Total Mg.
18.86	143.3	0.1190	...	1.2105	0.2016
5.47	41.6	0.0866	...	1.2105	0.2016
4.47	33.8	0.0035	...	1.2105	0.2016
1.54	11.7	...	0.0773	1.0766	0.2016
1.35	10.3	...	0.0765	0.7629	0.1492
1.07	8.2	...	0.0807	0.5952	0.1224
0.62	4.7	...	0.0701	0.3663	0.0865
0.60	4.6	...	0.0758	0.3417	0.0788
0.33	2.5	...	0.0748	0.2632	0.0655
0.21	1.6	...	0.0771	0.2229	0.0594
0.14	1.1	...	0.0710	0.2169	0.0566
0.03	0.3	...	0.0711	0.2036	0.0545
...	...	...	0.0685	0.2033	0.0536
...	...	...	0.0702	0.1960	0.0529
...	...	...	0.0625	0.2036	0.0520
...	...	...	0.0616	0.1954	0.0511
...	...	...	0.0641	0.1954	0.0518

CO

Therefore at 0 partial pressure of CO_2 and at 15° and mean barometric pressure, one liter of saturated aqueous solution contains 0.641 gm. of MgCO_3 plus 1.954 gms. $\text{Mg}(\text{HCO}_3)_2$.

It is pointed out by Johnston (1915) that although Treadwell and Reuter made very painstaking analyses, their mode of working did not secure equilibrium conditions, a fact which is borne out by the lack of constancy of the calculated solubility-product constant.

SOLUBILITY OF MAGNESIUM CARBONATE IN WATER CHARGED WITH CARBON DIOXIDE AT PRESSURES GREATER THAN ONE ATMOSPHERE.

(Engel and Ville — Compt. rend. 93, 340, '81; Engel — Ann. chim. phys. [6] 13, 340, '88.)

Pressure of CO_2 in Atmospheres.	G. MgCO_3^* per Liter.		Pressure of CO_2 in Atmospheres.	G. MgCO_3^* per Liter.	
	At 12° .	At 19° .		At 12° .	At 19° .
0.5	20.5	...	4.0	42.8	...
1.0	26.5	25.8	4.7	...	43.5
2.0	34.2	33.1 (2.1 At.)	6.0	50.6	48.5 (6.2 At.)
3.0	39.0	37.2 (3.2 At.)	9.0	...	56.6

SOLUBILITY IN WATER SATURATED WITH CO_2 AT ONE ATMOSPHERE.

(Engel.)

t° .	Gms. MgCO_3^* per Liter.	t° .	Gms. MgCO_3^* per Liter.	t° .	Gms. MgCO_3^* per Liter.
5	36	30	21	60	11
10	31	40	17	80	5
20	26			100	0

* Dissolved as $\text{Mg}(\text{HCO}_3)_2$.

SOLUBILITY OF MAGNESIUM CARBONATE IN WATER CONTAINING CARBON DIOXIDE
UNDER HIGH PRESSURES AND AT DIFFERENT TEMPERATURES.
(Haehnel, 1924.)

The saturated solutions were prepared in a platinum vessel provided with an electrically driven stirrer and contained in an autoclave. After stirring one hour and allowing to stand one-half hour the saturated solution was withdrawn through a platinum tube and analyzed by evaporating and weighing the ignited MgO. Equilibrium was approached from above. Magnesium carbonate from different sources was used.

Results at 18°.

Atmospheres Pressure.	Gms. Mg CO ₃ per 100 gms. sat. sol.
2.0	3.5
2.5	3.74
4.0	4.28
10.0	5.90
16.0	7.05
18.0	7.49
35.0	7.49
56.0	7.49

Results at different temperatures.

Gms. Mg CO ₃ per 100 gms. sat. sol. at			
1 atmosphere of CO ₂ (Engle and Ville).	3 atmospheres of CO ₂ (Beckurts).	34 atmospheres of CO ₂ (Haehnel).	
t°.			
0...	—	—	8.58
5...	—	—	8.32
10...	—	3.57	7.93
30...	1.58	—	6.88
40...	1.18	1.37	6.44
50...	0.95	—	6.18
60...	—	—	5.56

The determinations of Beckurts and of Engle and Ville were made in 1881 and 1885.

Electrolytic conductivity results are also given by Haehnel.

EQUILIBRIUM IN THE SYSTEM MAGNESIUM CARBONATE, AMMONIUM CARBONATE
AND WATER AT 30°. (Lafontaine, 1925.)

To a concentrated solution of magnesium bicarbonate containing 20-25 grams Mg (HCO₃)₂ per liter, increasing quantities of ammonia, ammonium bicarbonate or of mixtures of the two were added. The solutions were agitated mechanically 10 hours per day for 8 days. The composition of the solid phase did not change but its quantity increased with time. The zones of formation of the several solid phases were determined.

Mols. per 100 mols. H ₂ O.			Solid Phase.	Mols. per 100 mols. H ₂ O.			Solid Phase.
MgO	CO ₂	NH ₃		MgO	CO ₂	NH ₃	
0.160	1.487	1.193	Mg CO ₃ · 3 H ₂ O	0.006	1.593	10.386	1.1.4
0.103	2.508	2.099	"	0.091	2.172	1.932	" + Mg CO ₃ · 3 H ₂ O
0.097	2.256	0.129	"	0.021	0.463	1.351	" "
0.041	0.816	0.875	"	0.019	0.888	1.402	" "
0.021	0.089	0.144	"	0.012	1.300	1.582	" "
0.020	0.292	1.168	"	0.008	0.084	5.562	4.1.4 + "
0.055	0.952	0.970	"	0.008	0.095	11.029	" "
0.075	2.427	2.933	1.1.4	0.020	0.220	3.783	" + 3(11)
0.056	1.065	1.087	"	0.006	0.178	4.369	" "
0.026	1.315	1.514	"	0.015	0.196	5.524	" "
0.024	3.357	3.269	"	0.012	0.152	8.604	" "
0.016	0.623	1.277	"	0.001	0.010	10.981	" "
0.008	3.745	3.837	"	0.007	0.102	15.710	" "

$$1.1.4 = \text{MgCO}_3 \cdot (\text{NH}_4)_2\text{CO}_3 \cdot 4\text{H}_2\text{O}, \quad 4.1.4 = 4\text{MgCO}_3 \cdot \text{Mg}(\text{OH})_2 \cdot 4\text{H}_2\text{O}.$$

Data for the system magnesium carbonate-carbonic acid-water at 20°, 25°, 30°, 34° and 39° are given by Leather and Sen (1914). In connection with these results, it is pointed out by Johnston (1915), that it is questionable whether equilibrium was really obtained and furthermore, the accuracy of the analytical results cannot be trusted since the ratio of total amount of CO₂ in solution, to the magnesia is very irregular. The results when plotted directly show great inconsistencies.

THE CALCULATED SOLUBILITY OF MgCO₃·3H₂O IN WATER AT 18° IN CONTACT WITH AIR CONTAINING PARTIAL PRESSURES OF CO₂ FROM 0.0002 TO 0.0005 ATMOSPHERES.

(Johnston, 1915.)

It is shown that if the CO₂ pressure is kept constant at *P* and the water evaporated off so slowly at 18° that equilibrium conditions are continuously maintained, the following amounts of Mg(OH)₂ or of MgCO₃·3H₂O will be obtained.

Partial Pressure P of CO ₂ in Atms.	Total Mg $\frac{\text{Mols.}}{l}$	Gms. per Liter.
0	0.00015	0.0087 Mg(OH) ₂
0.00020	0.01934	1.13 "
0.00025	0.02218	1.29 "
0.00030	0.02486	1.45 "
0.00035	0.02742	1.60 "
0.00040	0.02868	3.97 MgCO ₃ ·3H ₂ O
0.00045	0.02924	4.05 "
0.00050	0.02976	4.12 "

SOLUBILITY OF MAGNESIUM CARBONATE IN NATURAL WATERS.

(Wells, 1915.)

(In all cases the solutions were in equilibrium with atmospheric air at 20°.)

Mixture.	Milligrams per Liter of Sat. Solution		
	Mg.	Free CO ₂	CO ₂ as bicarbonate.
Natural Magnesite in Distilled H ₂ O	0.018	trace	0.065
" in Aq. NaCl (27.2 g. per l.)	0.028	trace	0.086
MgCO ₃ ·3H ₂ O (equilibrium from bicarbonate end)	0.038	0.28 CO ₂ as carbonate	0.84
MgCO ₃ ·3H ₂ O (" undersaturation ")	0.034	0.32 CO ₂ "	0.59

SOLUBILITY OF MAGNESIUM CARBONATE IN AQUEOUS SOLUTIONS OF POTASSIUM BICARBONATE.

(Auerbach, 1904.)

The conditions necessary for preventing changes in equilibrium due to hydrolysis and loss of CO₂ are discussed. The mixtures were shaken from 1-4 days.

The sat. sol. analyzed for total alkali $\left(K + \frac{Mg}{2}\right)$ by titration with standard HCl using methyl orange as indicator. The neutralized solution was boiled to expel CO₂ and then excess 0.1 *N* NaOH added and the filtrate from magnesium precipitate back titrated with 0.1 *N* HCl. The $\frac{Mg}{2}$ was calculated from the used 0.1 *N* NaOH and the K obtained by difference.

Results at 15°.

Results at 25°.

Results at 35°.

Mols. per Liter.		Solid Phase.	Mols. per Liter.		Solid Phase.	Mols. per Liter.		Solid Phase.
KHCO ₃	MgCO ₃		KHCO ₃	MgCO ₃		KHCO ₃	MgCO ₃	
0	0.0095	MgCO ₃ ·3H ₂ O	0	0.0087	MgCO ₃ ·3H ₂ O	0	0.0071	MgCO ₃ ·3H ₂ O
0.0992	0.0131	"	0.0985	0.0115	"	0.1002	0.0098	"
0.1943	0.0167	"	0.2210	0.0140	"	0.2811	0.0142	"
0.3992	0.0211	" (labil)	0.3434	0.0181	"	0.4847	0.0177	"
0.2681	0.0192	" + 1.1	0.4985	0.0217	" (labil)	0.5867	0.0198	" (labil)
0.5243	0.0097	1.1	0.3906	0.0196	" + 1.1	0.5088	0.0184	" + 1.1
0.6792	0.0074	"	0.5893	0.0128	1.1	0.6231	0.0153	1.1
0.981	0.0028	"	0.6406	0.0117	"	0.8535	0.0119	"
1.1 = MgCO ₃ ·KHCO ₃ ·4H ₂ O.			1.125	0.0061	"			

Additional data for this system are given by Nanty, 1911.

Data for the solubility of MgCO₃ in aq. NaCl and other salt solutions, determined by prolonged boiling and subsequent cooling of the solution out of contact with air, are given by Gothe (1915).

SOLUBILITY OF MAGNESIUM CARBONATE IN AQUEOUS SOLUTIONS OF SODIUM CARBONATE AT 25°. The solutions being in equilibrium with an atmosphere free from CO₂.

(Cameron and Seidell — J. Physic. Ch. 7, 588, '03.)

Wt. of 1 Liter of Solution.	Grams per Liter.		Reacting Weights per Liter.	
	Na ₂ CO ₃ .	MgCO ₃ .	Na ₂ CO ₃ .	MgCO ₃ .
996.8	0.00	0.223	0.000	0.00266
1019.9	23.12	0.288	0.220	0.00344
1047.7	50.75	0.510	0.482	0.00620
1082.5	86.42	0.879	0.820	0.01027
1118.9	127.3	1.314	1.209	0.01570
1147.7	160.8	1.636	1.526	0.01955
1166.1	181.9	1.972	1.727	0.02357
1189.4	213.2	2.317	2.024	0.02770

SOLUBILITY OF MAGNESIUM BI CARBONATE AND OF MAGNESIUM CARBONATE IN AQUEOUS SOLUTIONS OF SODIUM CHLORIDE AT 23°. The solutions being in equilibrium with an atmosphere of CO₂ in the one case, and in equilibrium with air free from CO₂ in the other.

(C. and S.)

In Presence of CO ₂ as Gas Phase.			In Presence of Air Free from CO ₂ .		
Gms. NaCl per Liter.	Gms. Mg(HCO ₃) ₂ per Liter.	Wt. of 1 Liter.	Gms. NaCl per Liter.	Gms. MgCO ₃ per Liter.	
7.0	30.64	996.9	0.0	0.176	
56.5	30.18	1016.8	28.0	0.418	
119.7	27.88	1041.1	59.5	0.527	
163.9	24.96	1070.5	106.3	0.585	
224.8	20.78	1094.5	147.4	0.544	
306.6	10.75	1142.5	231.1	0.460	
		1170.1	272.9	0.393	
		1199.3	331.4	0.293	

SOLUBILITY OF MAGNESIUM CARBONATE IN AQUEOUS SOLUTIONS OF SODIUM SULPHATE AT 24° AND AT 35.5°. The solutions being in equilibrium with an atmosphere free from CO₂.

(Cameron and Seidell.)

Results at 24°.

Wt. of 1 Liter.	Gms. Na ₂ SO ₄ per Liter.	Gms. MgCO ₃ per Liter.
907.5	0.00	0.216
1021.2	25.12	0.586
1047.6	54.76	0.828
1080.9	95.68	1.020
1133.8	160.8	1.230
1157.3	191.9	1.280
1206.0	254.6	1.338
1242.0	305.1	1.388

Results at 35.5°.

Wt. of 1 Liter.	Gms. Na ₂ SO ₄ per Liter.	Gms. MgCO ₃ per Liter.
995.1	0.32	0.131
1032.9	41.84	0.577
1067.2	81.84	0.753
1094.8	116.56	0.904
1120.4	148.56	0.962
1151.7	186.7	1.047
1179.8	224.0	1.088
1236.5	299.2	1.130

MAGNESIUM OXALATE $\text{MgC}_2\text{O}_4 \cdot 2\text{H}_2\text{O}$.

One liter of sat. solution of magnesium oxalate in water contains 0.32 gm. MgC_2O_4 at 36° and 0.40 gm. at 92°.

(Chatterjee and Dhar, 1924.)

**SOLUBILITY OF MAGNESIUM OXALATE IN AQUEOUS SOLUTIONS
OF MAGNESIUM SULFATE AT 25°.**

(Walker, 1925.)

Gms. per liter sat. solution		Solid Phase
MgSO_4	MgC_2O_4	
0.0	0.345	$\text{MgC}_2\text{O}_4 \cdot 2\text{H}_2\text{O}$
0.327	0.264	"
0.591	0.241	"

**SOLUBILITY OF MAGNESIUM OXALATE IN AQUEOUS SOLUTIONS
OF AMMONIUM CHLORIDE AND AMMONIA AT 18°.**

(Fredholm, 1934.)

Composition of Aq. Solvent in Gm. Equiv. per liter	Gm. Equiv. Mg per liter sat. solution	Composition of Aq. Solvent in Gm. Equiv. per liter	Gm. Equiv. Mg per liter sat. solution	(1)
Water alone	0.0066(1)	0.0996 NH_4Cl + 0.599 NH_3	0.01044	
0.0996 NH_4Cl	0.00976	" + 0.798 "	0.01050	
" + 0.1996 NH_3	0.00999	" + 1.000 "	0.01079	
" + 0.3999 "	0.01013			

(1) This figure should probably be 0.0661 which corresponds to 0.304 gm. MgC_2O_4 per liter sat. solution in Water.

MAGNESIUM OXALATE

**SOLUBILITY OF MAGNESIUM OXALATE IN AQUEOUS SOLUTIONS
OF OXALIC ACID AND OF AMMONIUM SALTS.**

(Bobtelsky and Malkowa-Janowski, 1927.)

Results for Aqueous Solutions of:

Oxalic Acid			Ammonium Oxalate			Ammonium Chloride		
t°	Gms. per 100 gms. sat. sol.		t°	Gms. per 100 gms. sat. sol.		t°	Gms. per 100 gms. sat. sol.	
	$\text{H}_2\text{C}_2\text{O}_4$	Mg		$(\text{NH}_4)_2\text{C}_2\text{O}_4$	Mg		NH_4Cl	Mg
15	0.71	0.04703	15	0.87	0.01097	15	1.0	0.01057
"	3.14	0.06885	"	2.62	0.02492	"	2.0	0.02774
"	3.57	0.07757	"	4.36	0.03557	"	5.0	0.04215
100	1.79	0.0891	100	2.18	0.04286	"	10.0	0.04485
"	4.64	0.1234	"	5.24	0.1194	"	20.0	0.04365
"	7.15	0.1340	"	8.73	0.2269	100	1.0	0.04467
"	8.57	0.1446	"	10.47	0.3281	"	4.0	0.04441
"	14.29	0.1485	"	13.09	0.4845	"	8.0	0.05111
				17.45	0.7545	"	18.0	0.05008

The solid phase is $\text{Mg}_2\text{C}_2\text{O}_4 \cdot 2\text{H}_2\text{O}$ in all cases.

Mg MAGNESIUM

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SOLUBILITY OF MAGNESIUM OXALATE AT 18° IN AQUEOUS SOLUTIONS OF:
(Britton and Jarrett, 1936.)

Oxalic Acid

Sulfuric Acid

Gm. Mols. per liter sat. sol.		Solid Phase	Gm. Mols. per liter sat. sol.		Solid
$H_2C_2O_4$	MgC_2O_4		H_2SO_4	MgC_2O_4	
0.0	0.00230	$MgC_2O_4 \cdot 2H_2O$	0.05	0.0437	$MgC_2O_4 \cdot 2H_2O$
0.02	0.00997	"	0.125	0.0877	"
0.05	0.0155	"	0.25	0.1498	"
0.10	0.0217	"	0.50	0.2633	"
0.25	0.0322	"	1.00	0.4407	"
0.50	0.0513	"			

SOLUBILITY OF MAGNESIUM OXALATE IN AQUEOUS SOLUTIONS
OF SODIUM OXALATE AND VICE VERSA AT 18°.
(Britton and Jarrett, 1936.)

Gm. Mols. per liter sat. sol.		Solid Phase	Gm. Mols. per liter sat. sol.		Solid Phase
$Na_2C_2O_4$	MgC_2O_4		$Na_2C_2O_4$	MgC_2O_4	
0.00	0.00230	$MgC_2O_4 \cdot 2H_2O$	0.2384	0.0126	$MgC_2O_4 \cdot 2H_2O$
0.01	0.00246	"	0.2881	0.0164	"
0.02	0.00261	"	0.3093	0.0188	"
0.04	0.00325	"	0.3295	0.0205	"
0.06	0.00380	"	0.349	0.0185	$Na_2C_2O_4$
0.08	0.00439	"	0.368	0.0149	"
0.10	0.00529	"	0.396	0.0117	"
0.15	0.00794	"	0.2691	0.0062	"
0.20	0.01031	"	0.240	0.000	"

MAGNESIUM CHLORIDE $MgCl_2 \cdot 6H_2O$.

FREEZING-POINTS OF AQUEOUS SOLUTIONS OF MAGNESIUM CHLORIDE
(Rodebush, 1918.)

The temperatures were measured with thermoelements.

t° of freezing	3.71	8.46	13.29	19.57	25.86	33.51 (Eutec.)
Gms. $MgCl_2$ per 100 gms. H_2O	8.79	11.74	16.31	20.36	24.21	28.0

MAGNESIUM CHLORIDE $MgCl_2$.

SOLUBILITY IN WATER.

(van't Hoff and Meyerhoffer, 1898; Engel; Lowenherz. Results quoted from Landolt and Börnstein, 1912.)

t°	Gms. $MgCl_2$ per 100 Gms		Solid Phase.	t°	Gms. $MgCl_2$ per 100 Gms		Solid Phase.
	Solution.	Water.			Solution.	Water.	
-10	11.1	12.5	Ice	0	34.5	52.8	$MgCl_2 \cdot 6H_2O$
-20	16.0	19.0		10	34.9	53.5	"
-30	19.4	24.0	Ice + $MgCl_2 \cdot 12H_2O$	20	35.3	54.5	"
-33.6	20.6	26.0		22	35.6	55.2	"
-20	26.7	36.5	$MgCl_2 \cdot 12H_2O$	25	36.2	56.7	"
-16.4	30.6	44.04 f.pt.	"	40	36.5	57.5	"
-16.8	31.6	46.2	$MgCl_2 \cdot 12H_2O$ + $MgCl_2 \cdot 8H_2O$	60	37.9	61.0	"
-17.4	32.3	47.6*	$MgCl_2 \cdot 12H_2O$ + $MgCl_2 \cdot 8H_2O$	80	39.8	66.0	"
-19.4	33.3	49.9*	$MgCl_2 \cdot 12H_2O$ + $MgCl_2 \cdot 6H_2O$	100	42.2	73.0	"
-9.6	33.9	51.3*	$MgCl_2 \cdot 8H_2O$ + $MgCl_2 \cdot 6H_2O$	116.7	46.2	85.5	$MgCl_2 \cdot 6H_2O$ + $MgCl_2 \cdot 4H_2O$
-3.4	34.4	52.3	$MgCl_2 \cdot 8H_2O$ + $MgCl_2 \cdot 6H_2O$	152.6	49.1	96.4	$MgCl_2 \cdot 4H_2O$
			about	181.5	55.8	126.0	$MgCl_2 \cdot 2H_2O$ + $MgCl_2 \cdot 4H_2O$
				186	56.1	128.0	$MgCl_2 \cdot 2H_2O$

* = Unstable.

More recent determinations of the Solubility of Magnesium Chloride in water are as follows:

t°	Gms. MgCl ₂ per 100 gms. sat. sol.	Solid Phase	t°	Gms. MgCl ₂ per 100 gms. sat. sol.	Solid Phase
-15	14.69	Ice	60	37.90	MgCl ₂ ·6H ₂ O
-30	20.47	"	70	38.85	"
-30	22.19	MgCl ₂ ·12H ₂ O	80	39.80	"
-15	31.85	MgCl ₂ ·8H ₂ O α	90	41.00	"
-15	33.86*	MgCl ₂ ·6H ₂ O	100	42.20	"
0	34.61	"	100	42.40	"
+10	34.9	"	130	48.58	MgCl ₂ ·4H ₂ O
20	35.30	"	150	51.81	"
25	35.36	"	170	54.55	"
30	35.80	"	200	56.80	MgCl ₂ ·2H ₂ O
40	36.50	"	220	59.51	"
50	37.20	"	300	67.84	"

* Metastable.

The determinations below 0° are by Prutton, 1932; those from 0° to 100° are by Küpper, 1927, with which the results of Queisner, 1921, are in very close agreement; those above 100° are by Achumow and Wassiljew, 1932.

SOLUBILITY OF MAGNESIUM CHLORIDE IN AQUEOUS SOLUTIONS OF
HYDROCHLORIC ACID AT 0°.
(Engel — Compt. rend. 104, 433, '87.)

Milligram Mols. per 10 cc. Solution.		Sp. Gr. of Solutions.	Grams per Liter of Solution.	
HCl.	$\frac{1}{2}$ MgCl ₂ .		HCl.	MgCl ₂ .
0.0	99.55	1.362	0.0	474.2
4.095	95.5	1.354	14.93	454.8
9.5	90.0	1.344	34.63	428.6
17.0	82.5	1.300	61.97	393.0
20.5	79.0	1.297	74.74	376.2
28.5	71.0	1.281	103.9	338.3
42.0	60.125	...	153.1	286.4
58.75	46.25	...	214.2	220.3
76.0	32.0	...	277.1	152.0
			sat. HCl (Ditte)	6.5

100 gms. H₂O dissolve 52.65 gms. MgCl₂ at 3.5°, 55.26 gms. at 25° and 58.66 gms. at 50°. (Biltz and Marcus, 1911.)

SOLUBILITY OF BASIC MAGNESIUM CHLORIDE IN WATER AT 25°.

(Robinson and Wagaman, 1909.)

An excess of MgO was shaken with each of 20 MgCl₂ solutions at 25° for six months and the supernatant clear solutions and solid phases with adhering liquid, analyzed. The solutions were titrated with 0.02 N HCl for dissolved MgO (present as Mg(OH)₂). The composition of the solid phase in each case was ascertained by plotting the analytical results on a triangular diagram.

<i>d₂₅</i> of Sat. Sol.	Gms. per 100 Gms. Sat. Sol.		Solid Phase.	<i>d₂₅</i> of Sat. Sol.	Gms. per 100 Gms. Sat. Sol.		Solid Phase.
	MgCl ₂ .	MgO.			MgCl ₂ .	MgO.	
I. 019	2.36	0.00008	Indefinite	I. 141	17.53	0.0024	2MgO.HCl.5H ₂ O
I. 038	4.47	0.00028	Solid Solution	I. 162	18.52	0.0025	"
I. 056	6.79	0.00048	"	I. 192	22.04	0.00245	"
I. 075	9.02	0.00080	"	I. 245	26.88	0.0025	"
I. 111	13.14	0.00115	"	I. 274	29.80	0.0024	"
				I. 321	34.22	0.0030	"

EQUILIBRIUM IN THE SYSTEM MAGNESIUM CHLORIDE, MAGNESIUM OXIDE AND WATER AT 25°.

(Bury and Davies, 1932.)

Due to the formation of either cement or gels equilibrium is reached very slowly. Continuous shaking for two months is required. It is also necessary to keep the solid phase reduced to a fine powder by repeatedly breaking up the lumps. In order to avoid metastable equilibrium it is necessary to add a trace of finely ground magnesium cement which contains hydroxide and oxychloride. The MgO contained about 0.3% CaO. It was prepared by heating magnesium carbonate (light) to 850°. MgO which has been heated to higher temperatures or "burnt" is very slow in attaining equilibrium. Both the filtered saturated solutions and the solid phases were analyzed. The identities of the latter were ascertained by extrapolation by the Jänecke method.

Gms. MgCl ₂ per 100 gms. sat. sol.	Solid Phase	Gms. MgCl ₂ per 100 gms. sat. sol.	Solid Phase	Gms. MgCl ₂ per 100 gms. sat. sol.	Solid Phase
2.12	Mg(OH) ₂	12.08*	Mg(OH) ₂	26.59	1.3.11
2.65	"	15.32*	"	31.14	"
6.44	"	10.98	1.3.11	33.69	"
8.61	"	14.98	"	34.77	"
10.52	"	17.46	"	35.71	" + MgCl ₂ .6H ₂ O
10.89	" + 1.3.11	21.12	"	35.72	MgCl ₂ .6H ₂ O
10.62*	1.3.11	24.21	"		

* Metastable

1.3.11 = MgCl₂.3MgO.11H₂O. The authors consider that Robinson and Wagmans value for the triple point Mg(OH)₂ + 1.3.11, viz. 16.0% MgCl₂, erroneous due to their failure to recognize metastable equilibrium.

In a later paper, Bury and Davies, 1934, give results for the four component (reciprocal Salt pair) system MgCl₂ + CaO + H₂O at 25°. The authors discuss these results in their relation to the properties of magnesium oxychloride cements.

EQUILIBRIUM IN AQUEOUS SOLUTIONS CONTAINING MAGNESIUM CHLORIDE AND VARIOUS OTHER SALTS.

Several exhaustive papers describing the heterogeneous systems encountered in the technical production of particular salts from oceanic salt deposits have appeared in recent years. Among these should be mentioned those of Janecke, 1917, 1918, Serowy, 1923 and Frowein and von Mühlendahl, 1926. The experiments of Serowy are a repetition with great care, and an extension of the fundamental work of Van't Hoff, D'Ans and others. The compositions of the solutions saturated at regular intervals of temperature between 0° and 120° with all possible combinations of the solid phases, are shown in tables and triangular diagrams. The results are expressed in ion per cent of the constituents of the salts, Mg, K, Na, Cl and SO₄, and are also calculated to the molecular per cent and weight per cent basis and by the aid of density determinations, which are also given, to grams per liter. The paper of Janecke gives an exhaustive treatment of equilibria in heterogeneous systems. That of Frowein and von Mühlendahl is concerned particularly with double ternary mixtures derived from Mg, K₂, Na₂ (NO₃)₂ and Cl₂.

100 gms. sat. solution of magnesium chloride in selenium oxychloride (SeOCl₂) contain 4.96 gms. MgCl₂ at 25°.

(Wise, 1923.)

SOLUBILITY OF MIXTURES OF MAGNESIUM CHLORIDE, POTASSIUM CHLORIDE AND OF MAGNESIUM POTASSIUM CHLORIDE (CARNALLITE) IN WATER AT VARIOUS TEMPERATURES.

(van't Hoff and Meyerhoffer, 1899, 1912.)

t°.	Gms. per 100 Gms. H ₂ O.		Solid Phase.	Kind of Point on Curve.	
	MgCl ₂ .	KCl.			
- 11.1	...	24.6	Ice + KCl	Cryohydric of KCl	
- 33.6	26	...	" + MgCl ₂ .12H ₂ O	"	MgCl ₂ .12H ₂ O
- 34.3	22.7	1.24	" + KCl + MgCl ₂ .12H ₂ O	"	" + KCl
- 21	34.9	2.03	Carnallite + MgCl ₂ .12H ₂ O + KCl	Formation Temp. of Carnallite	
- 0	35.5	3.02	" + KCl	Point on Curve	
25	38.4	4.76	" + "	" "	
59	42	6.17	" + "	" "	(Uhlig, 1911.)
61.5	42.6	7.20	" + "	" "	
154.5	65.5	14.07	" + "	" "	
167.5	88.1	17.26	" + "	M. pt. of Carnallite	
25	55.5	0.83	" + MgCl ₂ .6H ₂ O	Point on Curve	
50	59.13	0.50	" + "	" "	(Uhlig, 1911.)
80	65	1.24	" + "	" "	
115.7	85.6	1.66	" + " + MgCl ₂ .4H ₂ O	Transition Point	[Carnallite
152.5	105.7	9.93	" + MgCl ₂ .4H ₂ O + KCl	Upper Formation Temp. of	
176	126.9	16.97	MgCl ₂ .4H ₂ O + MgCl ₂ .2H ₂ O + KCl	Transition Point	
186	126.9	26.1	MgCl ₂ .2H ₂ O + KCl	Point on Curve	

Carnallite = MgKCl₃.6H₂O.

SOLUBILITY OF MIXTURES OF MAGNESIUM CHLORIDE AND OTHER SALTS IN WATER AT 25°.

(Löwenherz, 1894.)

Mixture.	Gms. Mols. per 1000 Mols. H ₂ O.	Gms. per Liter of Solution.
MgCl ₂ .6H ₂ O + MgSO ₄ .6H ₂ O	104 MgCl ₂ + 14 MgSO ₄	25. Cl + 4.4 SO ₄
MgCl ₂ .7H ₂ O + MgSO ₄ .6H ₂ O	73 " + 15 "	19.5 Cl + 5.3 SO ₄
MgCl ₂ .6H ₂ O + MgCl ₂ .KCl.6H ₂ O	106 Cl ₂ + 1 K ₂ + 105 Mg	26.9 Cl + 0.3 K + 45.7 SO ₄

Results for all possible combinations of magnesium sulfate and potassium chloride and of magnesium chloride and potassium sulfate are also given.

100 cc. anhydrous hydrazine dissolve 2 gms. MgCl₂ at room temp. A flocculant pt. separates on standing.

(Welsh and Broderick, 1915.)

Mg MAGNESIUM MAGNESIUM CHLORIDE

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Data for the System $\text{MgCl}_2 + \text{KCl} + \text{MgSO}_4 + \text{K}_2\text{SO}_4 + \text{H}_2\text{O}$ at 100° are given by Campbell, Downes and Samis, 1934.

Data for the System $\text{MgCl}_2 + \text{KCl} + \text{NaCl}$ at temperatures above 100° are given by Achoumow and Wassilijew, 1932.

SOLUBILITY OF MAGNESIUM CHLORIDE IN AQUEOUS SOLUTIONS OF POTASSIUM PERMANGANATE AT 25° .

(Herz and Hiebenthal, 1929.)

Gm. Mols. per liter sat. sol.	
$1/5\text{-KMnO}_4$	$1/2\text{MgCl}_2$
0.0	9.56
0.10	9.46
+0.16	9.52

SOLUBILITY OF MAGNESIUM CHLORIDE IN AQUEOUS SOLUTIONS OF MAGNESIUM NITRATE AND VICE VERSA.

(Sievarts and Müller, 1930.)

C1

d. of sat. sol.	Gms. per 100 gms. sat. sol.		Solid Phase	d. of sat. sol.	Gms. per 100 gms. sat. sol.		Solid Phase
	MgCl_2	$\text{Mg}(\text{NO}_3)_2$			MgCl_2	$\text{Mg}(\text{NO}_3)_2$	

Results at 15°

1.336	35.0	0.0	$\text{MgCl}_2 \cdot 6\text{H}_2\text{O}$
1.352	32.5	4.29	"
1.371	29.9	8.24	"
1.386	27.7	12.2	"
1.397	26.1	14.9	" + Mg6
1.379	20.0	19.5	Mg6
1.373	15.0	24.2	"
1.372	9.54	29.9	"
1.373	5.04	34.4	"
1.377	0.0	40.5	"

Results at 25° (con.)

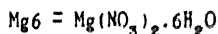
1.384	13.7	27.1	Mg6
1.376	8.72	32.7	"
1.382	4.60	36.8	"
1.387	0.0	41.9	"

Results at 50°

1.345	37.0	0.0	$\text{MgCl}_2 \cdot 6\text{H}_2\text{O}$
1.372	33.3	6.5	"
1.424	26.4	18.5	"
1.452	23.0	24.4	"
1.462	21.6	26.5	" + Mg6
1.443	18.2	28.6	Mg6
1.425	13.0	32.7	"
1.419(?)	9.75	35.9	"
1.414(?)	6.16	39.3	"
1.415	3.12	42.4	"
1.418	0.0	46.0	"

Results at 25°

1.338	35.5	0.0	$\text{MgCl}_2 \cdot 6\text{H}_2\text{O}$
1.353	33.1	4.06	"
1.372	30.7	8.25	"
1.386	28.6	11.5	"
1.412	24.9	17.8	" + Mg6
1.392	18.3	22.7	Mg6



The authors give similar results for the Reciprocal Salt Pair $\text{MgCl}_2 + \text{NaNO}_3 + \text{H}_2\text{O}$ at 15° , 25° and 50° .

MAGNESIUM CHLORIDE

SOLUBILITY OF MAGNESIUM CHLORIDE IN AQUEOUS SOLUTIONS
OF MAGNESIUM NITRATE AND VICE VERSA.
(Sleverts and Muller, 1931.)

d. of sat. sol.	Gms. per 100 gms. sat. sol.		Solid Phase	d. of sat. sol.	Gms. per 100 gms. sat. sol.		Solid Phase
	MgCl ₂	Mg(NO ₃) ₂			MgCl ₂	Mg(NO ₃) ₂	
Results at 75°				Results at 110°			
1.360	39.1	0.0	MgCl ₂ ·6H ₂ O	1.40	44.3	0.0	MgCl ₂ ·6H ₂ O
1.380	34.6	7.3	"	—	43.95	3.65	" + MgCl ₂ ·4H ₂ O
1.390	33.4	9.4	"	—	28.3	29.1	MgCl ₂ ·4H ₂ O
—	28.5	17.6	"	—	23.1	41.7	"
—	24.3	28.2	"	—	22.4	45.2	"
—	25.8	30.2	" + MgCl ₂ ·4H ₂ O	—	23.3	46.0	"
1.575	23.0	37.5	MgCl ₂ ·4H ₂ O	—	22.2	47.4	" + MgCl ₂ ·2H ₂ O
—	17.1	46.2	"	1.60	20.1	50.8	MgCl ₂ ·2H ₂ O
—	13.1	54.0	" + Mg(NO ₃) ₂ ·2H ₂ O	—	19.3	51.8	"
—	11.6	56.1	Mg(NO ₃) ₂ ·2H ₂ O	1.58	17.5	54.0	"
1.679	4.9	63.1	"	—	16.3	56.9	"
—	3.9	65.3	"	—	16.6	57.8	"
—	1.8	67.8	"	—	16.0	57.8	"
—	0.0	68.8	"	—	15.9	58.7	"
1.461	0.0	50.6	Mg(NO ₃) ₂ ·6H ₂ O	—	14.9	58.5	"
1.528	9.9	43.2	"	—	14.2	59.3	"
—	9.0	48.0	"	—	15.0	61.0	" + Mg(NO ₃) ₂ ·2H ₂ O
1.581	6.5	53.3	"	—	9.95	65.0	Mg(NO ₃) ₂ ·2H ₂ O
—	7.0	57.7	"	—	0.0	73.5	"
—	0.0	63.4	"				

Cl

The authors give similar results for the Reciprocal Salt Pair
MgCl₂ + NaNO₃ + H₂O at 75° and at 110°.

EQUILIBRIUM IN THE SYSTEM MAGNESIUM CHLORIDE
MAGNESIUM SULFATE AND WATER AT 100°.

(Campbell, Downes and Sells, 1934.)

Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase
MgCl ₂	MgSO ₄		MgCl ₂	MgSO ₄	
42.40	0.00	MgCl ₂ ·6H ₂ O	36.9	2.81	MgSO ₄
41.20	1.08	MgSO ₄	37.35	2.82	" + MgSO ₄ ·H ₂ O
41.50	1.23	"	31.0	3.30	MgSO ₄ ·H ₂ O
40.25	0.87	"	20.85	9.05	"
40.60	0.60	"	19.85	8.65	"
33.16	0.37	"	12.50	16.30	"
29.0	0.99	"	8.42	21.20	"
37.6	2.12	"	2.83	29.50	"
			0.0	33.50	"

These authors also give data for the systems MgCl₂ + MgSO₄ + KCl + K₂SO₄ at 100°.

Data for the System MgCl₂ + MgSO₄ + NaCl + Na₂SO₄ at 0°, 5°, 15.3°, 17.9°, 20.6°, 25°, 27°, 31°, 35.5°, 49°, 55°, 57°, 59°, 61°, 64°, 71° and 83° are given by Küpper, 1927.

EQUILIBRIUM IN THE SYSTEM MAGNESIUM CHLORIDE, MAGNESIUM SULFATE AND WATER.

Results of Kournakow and Zemczunyj, 1919, 1924 :

At 0°.

Mols. per 1000 mols. H ₂ O.		Solid Phase.
MgCl ₂ .	MgSO ₄ .	
99.8	0.0	MgCl ₂ ·6H ₂ O
97.7	3.4	»+MgSO ₄ ·7H ₂ O
84.0	3.3	MgSO ₄ ·7H ₂ O
78.2	3.3	»
71.8	3.5	»
64.1	4.2	»
42.8	8.1	»
23.7	16.8	»
9.2	27.6	»
0.0	38.9	»

At 23°.

Mols. per 1000 mols. H ₂ O.		Solid Phase.
MgCl ₂ .	MgSO ₄ .	
104.9	0.0	MgCl ₂ ·6H ₂ O
100.1	9.3	»+MgSO ₄ ·6H ₂ O
91.6	9.0	MgSO ₄ ·6H ₂ O
80.1	9.2	»+MgSO ₄ ·7H ₂ O
68.3	10.7	MgSO ₄ ·7H ₂ O
60.4	12.0	»
39.3	19.0	»
20.4	31.4	»
17.2	34.6	»
8.0	45.0	»

Results of Takegami, 1921, at 23°.

Gms. per 100 gms. sat. sol.		Solid Phase.
MgCl ₂ .	MgSO ₄ .	
35.86	0.0	MgCl ₂ ·6H ₂ O
34.80	1.45	»
33.89	2.99	»
34.03	2.96	»+MgSO ₄ ·4H ₂ O
33.56	2.81	MgSO ₄ ·4H ₂ O
33.09	2.82	»
32.97	2.91	MgSO ₄ ·5H ₂ O
32.48	3.04	»
30.79	3.87	»
32.36	3.85	MgSO ₄ ·6H ₂ O
32.14	3.77	»
31.39	3.75	»
30.91	3.76	»
30.08	3.80	»

Gms. per 100 gms. sat. sol.		Solid Phase.
MgCl ₂ .	MgSO ₄ .	
28.72	4.14	MgSO ₄ ·6H ₂ O
28.21	4.35	»
27.84	4.29	»
26.36	4.90	»
26.06	5.02	»+MgSO ₄ ·7H ₂ O
23.53	5.44	MgSO ₄ ·7H ₂ O
16.22	10.14	»
14.77	11.08	»
14.05	10.68	»
10.51	14.02	»
9.42	14.89	»
5.31	19.63	»
1.62	24.43	»
0.0	26.68	»

In both cases constant agitation was employed and all necessary precautions for accuracy were observed.

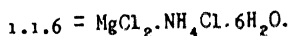
SOLUBILITY OF MIXTURES OF AMMONIUM CHLORIDE AND MAGNESIUM CHLORIDE IN WATER. (Riltz and Marcus, 1911.)

t°.	Gms. per 100 Gms. Sat. Sol.		Solid Phase.	t°.	Gms. per 100 Gms. Sat. Sol.		Solid Phase.
	MgCl ₂ .	NH ₄ Cl.			MgCl ₂ .	NH ₄ Cl.	
3.5	21.41	5.93	NH ₄ Cl+MgCl ₂ ·6H ₂ O	3.5	34.43	0.09	(NH ₄)MgCl ₂ ·6H ₂ O
25	20.95	8.78	»	25	35.41	0.09	»+MgCl ₂ ·6H ₂ O
50	20.84	12.46	»	50	36.92	0.15	»

SOLUBILITY OF MAGNESIUM CHLORIDE IN AQUEOUS SOLUTIONS
OF AMMONIUM CHLORIDE AND VICE VERSA.
(Woskressenski, 1934.)

Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase
MgCl ₂	NH ₄ Cl		MgCl ₂	NH ₄ Cl	

Results at 25°			Results at 60° (con.)		
35.7	0.0	MgCl ₂ ·6H ₂ O	20.7	14.3	1.1.6 + NH ₄ Cl
35.55	0.08	" + 1.1.6	18.5	15.9	NH ₄ Cl
28.05	1.31	1.1.6	15.5	18.6	"
25.71	3.0	"	8.4	26.0	"
23.88	4.88	"	0.0	35.6	"
21.08	8.69	" + NH ₄ Cl	Results at 115°		
12.36	15.75	NH ₄ Cl	45.0	0.0	MgCl ₂ ·6H ₂ O
7.50	20.45	"	44.8	0.17	" + 1.1.6
0.0	28.26	"	41.9	0.54	1.1.6
Results at 60°			35.6	3.29	"
37.9	0.0	MgCl ₂ ·6H ₂ O	26.7	12.4	"
38.2	0.15	" + 1.1.6	21.2	22.3	" + NH ₄ Cl
35.9	0.49	1.1.6	19.0	24.1	NH ₄ Cl
31.7	1.2	"	9.5	34.2	"
27.8	3.6	"	4.2	40.7	"
22.1	11.8	"	0.0	46.5	"



The author also made a long series of determinations by the freezing-point method (observing the temperature of the appearance of first crystal) and from these results obtained the values for the isotherms at -10°, -20°, -25°, as well as for the invariant points of the system at other temperatures.

EQUILIBRIUM IN THE SYSTEM MAGNESIUM CHLORIDE, SODIUM CHLORIDE
AND WATER AT 0° AND AT 25°.

(Kournakov and Zencuznyj, 1919, 1924.)

Results at 0°.			Results at 25°		
Mols. per 1000 mols. H_2O		Solid Phase.	Mols. per 1000 mols. H_2O		Solid Phase
MgCl_2	NaCl		MgCl_2	NaCl	
99.8	0.0	$\text{MgCl}_2 \cdot 6\text{H}_2\text{O}$	104.9	0.0	$\text{MgCl}_2 \cdot 6\text{H}_2\text{O}$
98.0	1.7	" + NaCl	102.5	2.45	" + NaCl
75.0	3.2	NaCl	95.0	3.0	NaCl
49.1	12.8	"	79.2	4.1	"
38.0	20.0	"	58.5	9.0	"
18.95	37.0	"	48.4	14.5	"
0.0	54.9	"	40.5	19.5	"
			26.7	29.6	"
			16.0	40.0	"
			0.0	55.5	"

Data for the Systems:

$\text{MgCl}_2 + \text{NaCl} + \text{Na}_2\text{SO}_4$ at 0° and at 50°
 $\text{MgCl}_2 + \text{NaCl} + \text{Na}_2\text{SO}_4 + \text{NaNO}_3$ at 10° and 50°
 $\text{MgCl}_2 + \text{NaCl} + \text{Na}_2\text{SO}_4 + \text{NaNO}_3 + \text{Mg}(\text{NO}_3)_2$ at 50°
 are given by Leinbach and Pfeiffenberger, 1929, 1930.

EQUILIBRIUM IN THE SYSTEM MAGNESIUM CHLORIDE, SODIUM CHLORIDE
AND WATER AT DIFFERENT TEMPERATURES. (Keitel, 1923.)

Gms. per 100 gms. sat. sol.				Gms. per 100 gms. sat. sol.			
t°.	Mg Cl ₂ .	Na Cl.	Solid Phase.	t°.	Mg Cl ₂ .	Na Cl.	Solid Phase.
15...	35.10	0.0	Mg Cl ₂ ·6H ₂ O	55...	8.29	18.34	Na Cl
15...	23.84	3.68	Na Cl	55...	7.37	19.30	»
15...	15.80	10.07	»	55...	0.0	27.01	»
15...	7.60	18.95	»	83...	39.81	0.0	Mg Cl ₂ ·6H ₂ O
25...	35.60	0.0	Mg Cl ₂ ·6H ₂ O	83...	38.80	0.40	» + Na Cl
25...	35.00	0.97	» + Na Cl	83...	34.89	0.74	Na Cl
25...	30.87	1.39	Na Cl	83...	30.86	2.28	»
25...	24.28	4.01	»	83...	22.51	7.65	»
25...	9.68	16.38	»	83...	15.37	12.91	»
25...	8.01	17.74	»	83...	7.83	20.81	»
55...	37.55	0.0	Mg Cl ₂ ·6H ₂ O	83...	0.0	27.60	»
55...	37.51	0.28	» + Na Cl	105...	43.47	0.0	Mg Cl ₂ ·6H ₂ O
55...	34.49	0.97	Na Cl	105...	42.93	0.09	» + Na Cl
55...	30.80	1.65	»	105...	31.01	2.61	Na Cl
55...	25.05	4.32	»	105...	24.68	7.22	»
55...	23.59	5.01	»	105...	0.0	28.35	»
55...	16.18	10.74	»				

Cl

A solution of Bischofite (Mg Cl₂·6H₂O) served as the starting solution. The solutions were stirred constantly for not less than two hours.

The following determinations at 25° are given by Takegami, 1921.

Gms. per 100 gms. sat. sol.		
Mg Cl ₂ .	Na Cl.	Solid Phase.
35.86	0.0	Mg Cl ₂ ·6H ₂ O
35.73	0.21	»
35.68	0.48	» + Na Cl
31.65	1.12	Na Cl
24.40	4.11	»
18.79	7.80	»
9.15	16.62	»
6.24	19.77	»
0.5	26.49	»

EQUILIBRIUM IN THE SYSTEM MAGNESIUM CHLORIDE, MAGNESIUM SULFATE,
SODIUM CHLORIDE, SODIUM SULFATE AND WATER AT 103°. (Mayer, 1920.)

Mols. per 1000 mols. H ₂ O.				Solid Phase.
Mg Cl ₂ .	Mg SO ₄ .	Na ₂ Cl ₂ .	Na ₂ SO ₄ .	
133.0	-	0.225	-	Na Cl
139.5	-	trace	-	Mg Cl ₂ ·Na Cl·6H ₂ O
138.5	1.5	-	-	Mg Cl ₂ ·6H ₂ O + Mg SO ₄ ·H ₂ O
123.1	2.02	-	-	Mg SO ₄ ·H ₂ O
-	76.69	-	-	»
-	64.31	-	13.07	» + 2Na ₂ SO ₄ ·2Mg SO ₄ ·5H ₂ O
-	41.84	-	32.22	3Na ₂ SO ₄ ·Mg SO ₄ + »
-	49.88	-	11.05	» + Na ₂ SO ₄
-	-	-	52.99	Na ₂ SO ₄
-	-	57.99	8.054	» + Na Cl
4.632	-	52.78	7.382	» + » + 3Na ₂ SO ₄ ·Mg SO ₄
33.64	-	27.02	10.12	Na Cl + 3Na ₂ SO ₄ ·Mg SO ₄ + 2Na ₂ SO ₄ ·2Mg SO ₄ ·5H ₂ O
55.40	-	9.978	11.32	Na Cl + 2Na ₂ SO ₄ ·2Mg SO ₄ ·5H ₂ O + Mg SO ₄ ·H ₂ O

EQUILIBRIUM IN THE SYSTEM MAGNESIUM CHLORIDE, MAGNESIUM SULFATE,
SODIUM CHLORIDE, SODIUM SULFATE AND WATER AT 0° AND AT 25°.

(Kournakoff and Zemczujny, 1919, 1924)

Mols. per 1000 mols H ₂ O.					Solid Phase.
t°.	MgCl ₂ .	MgSO ₄ .	Na ₂ Cl ₂ .	Na ₂ SO ₄ .	
0..	96.5	3.9	1.1	0.0	MgCl ₂ ·6H ₂ O + MgSO ₄ ·7H ₂ O + NaCl
0..	85.7	2.9	1.0	0.0	MgSO ₄ ·7H ₂ O + NaCl
0..	48.2	6.0	11.0	0.0	" "
0..	25.2	12.0	25.3	0.0	MgSO ₄ ·7H ₂ O + Na ₂ SO ₄ ·10H ₂ O + NaCl
0..	23.7	13.3	19.2	0.0	MgSO ₄ ·7H ₂ O + Na ₂ SO ₄ ·10H ₂ O
0..	11.0	23.8	9.7	0.0	" "
0..	0.0	38.5	0.0	6.5	" "
25..	100.0 (101.85)	9.5 (3.78)	2.5 (0.28)	0.0	MgCl ₂ ·6H ₂ O + MgSO ₄ ·6H ₂ O + NaCl
25..	— (103.9)	0.0	0.0	0.0	" + NaCl
25..	— (102.1)	— (5.4)	0.0	0.0	" + MgSO ₄ ·6H ₂ O
25..	— (77.0)	— (9.53)	0.0	0.0	MgSO ₄ ·7H ₂ O
25..	77.7 (75.8)	9.8 (9.78)	2.3 (3.39)	0.0	" + " + NaCl
25..	— (71.79)	— (18.0)	— (15.08)	0.0	" + " + " + "
25..	30.2	15.1	22.0	0.0	MgSO ₄ + " + " + "
25..	53.6	13.8	8.8	0.0	MgSO ₄ ·7H ₂ O + NaCl
25..	44.2	17.0	12.4	0.0	" "
25..	37.4	16.1	16.4	0.0	" "
25..	35.6	16.2	17.1	0.0	" "
25..	24.2	15.3	26.6	0.0	1, 1, 4 + NaCl
25..	17.6	15.0	31.9	0.0	" "
25..	13.1	16.0	36.1	0.0	" "
25..	4.1	16.9	43.6	0.0	" "
25..	30.2	14.3	21.0	0.0	" + MgSO ₄ (7H ₂ O?)
25..	21.9	22.2	19.8	0.0	" "
25..	4.5	38.6	18.1	0.0	" "
25..	3.8	39.8	19.7	0.0	" "
25..	0.0	45.1	14.2	8.9	" "
25..	0.0	44.2	8.2	18.3	" "
25..	0.0	45.3 (47.90)	0.0	28.1 (25.97)	" "
25..	0.0	16.0	46.9	2.03	" + NaCl + Na ₂ SO ₄
25..	0.0	15.9 (18.84)	46.8 (48.72)	2.5 (1.38)	" "
25..	0.0	15.6	39.7	9.7	" + Na ₂ SO ₄ 10H ₂ O + "
25..	0.0	17.2 (11.54)	30.4 (23.89)	16.6 (23.67)	" "
25..	0.0	— [11.6]	— [26.3]	— [26.0]	" " Rose, 1925
25..	0.0	— [30.8]	— [10.2]	— [32.3]	" " Takemami, 1929
25..	0.0	17.7	28.5	18.6	" + Na ₂ SO ₄ ·10H ₂ O
25..	0.0	18.1	25.4	20.1	" "
25..	0.0	19.3	22.6	24.3	" "
25..	0.0	20.2	20.8	25.6	" "
25..	0.0	25.0	11.8	31.3	" "
25..	0.0	36.2 (37.96)	0.0	35.8 (34.36)	" "
25..	0.0	17.2	30.1	16.6	" + " + Na ₂ SO ₄
25..	0.0	16.0	46.8	2.2	" + NaCl + " + "
25..	0.0	0.0	31.4 (29.6)	26.9 (27.8)	Na ₂ SO ₄ ·10H ₂ O + Na ₂ SO ₄
25..	0.0	5.7	30.2	23.1	" "
25..	0.0	12.1	30.1	19.8	" "
25..	0.0	0.0	50.9 (49.56)	12.4 (12.11)	NaCl + " + "
25..	0.0	8.1	48.6	7.0	" "
25..	0.0	4.7	35.8	21.0	" + Na ₂ SO ₄
25..	0.0	11.8	41.5	11.0	"

1, 1, 4 = astrakanite, MgSO₄·Na₂SO₄·4H₂O. The results in parentheses are by Blasdale, 1920.

Data for the systems composed of Magnesium and Sodium Chlorides, Nitrates and Sulfates at 0°, 10°, 25° and 50° are given by Leinbach,

Mg MAGNESIUM

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MAGNESIUM CHLORIDE

EQUILIBRIUM IN THE SYSTEM MAGNESIUM CHLORIDE, RUBIDIUM CHLORIDE, POTASSIUM CHLORIDE AND WATER AT 25°.

(D'Ans and Busch, 1937.)

Gm. Mols. per 1000 gms. H ₂ O			Mols. Rb per 100 mols. Rb + K in:		Solid Phase
MgCl ₂	RbCl	KCl	sat. sol.	Solid Phase	
104.0	trace	0.0	—	—	MgCl ₂ ·6H ₂ O + 1.1.6
49.2	24.8	0.0	—	—	1.1.6
(31.0)	(38.0)	1.3	100	—	" + RbCl
32.2	36.7	0.0	—	—	"
(72.0)	0.0	(5.5)	0.0	—	KCl + KCl·MgCl ₂ ·6H ₂ O
57.3	6.2	7.9	44.0	—	(K, Rb)Cl + (K, Rb)Cl·MgCl ₂ ·6H ₂ O
50.2	12.9	10.2	55.7	—	" " "
44.3	29.7	7.2	81.5	—	" " "
41.5	33.3	5.7	85.0	—	" " "
68.7	0.4	7.0	4.8	0.0	(K, Rb)Cl
72.3	0.6	5.9	9.7	17.2	(K, Rb)Cl·MgCl ₂ ·6H ₂ O
46.5	19.7	8.8	69.2	86.0	"
34.0	32.8	8.5	79.3	54.1	(K, Rb)Cl
45.0	27.4	3.5	89.0	95.4	(K, Rb)Cl·MgCl ₂ ·6H ₂ O
50.3	18.0	9.4	65.7	83.4	"
48.7	18.2	6.8	72.3	86.5	"
46.6	19.0	6.3	75.1	90.2	"
49.3	21.9	4.0	86.3	91.6	"

1.1.6 = MgCl₂·RbCl·6H₂O (Rubidium Carnallite)

MAGNESIUM CHLORIDE Methyl and Ethyl Alcoholates.

SOLUBILITY OF MAGNESIUM CHLORIDE METHYL ALCOHOLATE IN METHYL ALCOHOL.

(Lloyd, Brown, Olynwyn, Bonnel and Jones, 1928.)

t°	Gms. MgCl ₂ per 100 gms. CH ₃ OH	Solid Phase	t°	Gms. MgCl ₂ per 100 gms. CH ₃ OH	Solid Phase
0	15.5	MgCl ₂ ·6CH ₃ OH	40	17.8	MgCl ₂ ·6CH ₃ OH
10	15.7	"	50	19.0	"
20	16.0	"	60	20.4	"
30	16.7	"			

SOLUBILITY OF MAGNESIUM CHLORIDE ETHYL ALCOHOLATE IN ETHYL ALCOHOL.

(Lloyd, Brown, Olynwyn, Bonnel and Jones, 1928.)

t°	Gms. MgCl ₂ per 100 gms. C ₂ H ₅ OH	Solid Phase	t°	Gms. MgCl ₂ per 100 gms. C ₂ H ₅ OH	Solid Phase
0	3.61	MgCl ₂ ·6C ₂ H ₅ OH	50	12.80	MgCl ₂ ·6C ₂ H ₅ OH
10	4.34	"	60	15.89	"
20	5.60	"	65	17.20	"
30	7.40	"	70	18.63	"
40	10.00	"			

Fusion-point data are given for mixtures of:

MgCl ₂ + MgSO ₄ (Jänecke, 1912.)	MgCl ₂ + PbCl ₂ (Menge, 1911.)
" + MnCl ₂ (Sandonnini, 1912, -1914.)	" + SnCl ₂ " "
" + NaCl (Scholich, 1920; Menge, 1911.)	" + SrCl ₂ (Sandonnini, 1912, 1914.)
" + KCl (Scholich, 1920.)	" + TiCl ₃ (Korring, 1914.)
" + " + NaCl " "	" + ZnCl ₂ (Menge, 1911.)

MAGNESIUM CHLORATE Mg(ClO₃)₂·6H₂O.

SOLUBILITY IN WATER.

(Meusser — Ber. 35, 1416, '02.)

°.	Gms. Mg(ClO ₃) ₂ per 100 Gms. Solution.	Mols. Mg(ClO ₃) ₂ per 100 Mols. H ₂ O.	Solid Phase.	°.	Gms. Mg(ClO ₃) ₂ per 100 Gms. Solution.	Mols. Mg(ClO ₃) ₂ per 100 Mols. H ₂ O.	Solid Phase.
-18	51.64	10.05	Mg(ClO ₃) ₂ ·6H ₂ O	42	63.82	16.60	Mg(ClO ₃) ₂ ·4H ₂ O
0	53.27	10.73	"	65.5	69.12	20.08	"
18	56.50	12.22	"	39.5	65.37	17.76	Mg(ClO ₃) ₂ ·2H ₂ O
29	60.23	14.25	"	61.0	69.46	21.40	"
35	63.65	16.48	"	68	70.69	22.69	"
				93	(73.71)	(26.38)	"

Sp. Gr. of saturated sol. at + 18° = 1.564.

C10

MAGNESIUM Per CHLORATE Mg(ClO₄)₂·6H₂O and 3H₂O.

SOLUBILITY OF HYDRATED MAGNESIUM PERCHLORATE IN WATER
AND OF ANHYDROUS MAGNESIUM PERCHLORATE IN OTHER SOLVENTS AT 25°.
(Willard and Smith, 1926.)

Solvent.	d of solvent.	d of sat. sol.	Gms. Mg(ClO ₄) ₂ per 100 gms. sat. sol.	Solvent	d of solvent	d of sat. sol.	Gms. Mg(ClO ₄) ₂ per 100 gms. sat. sol.
Water.....	—	1.4720	49.90	iso Butyl alcohol.	0.7981	1.0609	31.27
Methyl alcohol...	0.78705	1.1057	34.14	Acetone.....	0.7864	1.0798	30.015
Ethyl alcohol....	0.78515	0.9518	19.33	Ethyl acetate...	0.8947	1.3057	41.49
n Propyl alcohol.	0.7989	1.1926	42.33	Ethyl ether...	0.7081	0.7101	0.99
n Butyl alcohol..	0.8059	1.1399	39.16				

MAGNESIUM Hexa Antipyrine Per CHLORATE [Mg(COC₁₀H₁₂N₂)₆](ClO₄)₂.

100 gms. sat. solution of Magnesium Hexa Antipyrine Perchlorate in Water contain 7.69 gms. [Mg(COC₁₀H₁₂N₂)₆](ClO₄)₂ at 20°. (Wilke, Dörfurt and Schliephake, 1929.)

MAGNESIUM CHROMATE MgCrO₄·7H₂O.

100 grams H₂O dissolve 72.3 grams MgCrO₄ at 18°, or 100 grams solution contain 42.0 grams. Sp. Gr. = 1.422.
(Myhus and Funk, 1897.)

MAGNESIUM POTASSIUM CHROMATE MgCrO₄·K₂CrO₄·2H₂O.

100 grams H₂O dissolve 28.2 grams at 20°, and 34.3 grams at 60°.

(Schweitzer.)

MAGNESIUM FLUORIDE MgF_2

SOLUBILITY OF MAGNESIUM FLUORIDE IN WATER.

t°	Gms. MgF_2 per liter sat. sol.	Authority
18	0.076 (conductivity method)	(Kohlrausch, 1905.)
27	0.084 " "	(" " 1908.)
25	0.130 (analytical method)	(Carter, 1928.)

SOLUBILITY OF MAGNESIUM FLUORIDE IN AQUEOUS SOLUTIONS
OF HYDROCHLORIC ACID.

(Tananaev and Tchrelachwill, 1936.)

Normality of Aq. HCl	Gm. Mols. MgF_2 dissolved per liter	pH of sat. sol.
0.01	0.0036	1.94
0.10	0.0086	1.15
1.00	0.0428	0.25

F

F. pt data for $MgF_2 + NaF$ are given by Grube, 1927 and Jaisle, 1926.MAGNESIUM Hexa Antipyrine Boro FLUORIDE $[Mg(COC_{10}H_{12}N_2)_6](BF_4)_2$.

100cc sat. solution of Magnesium Hexa antipyrine Boro fluoride in Water contain 6.6 gms. $[Mg(COC_{10}H_{12}N_2)_6](BF_4)_2$ at 20° . (Wilke, Dörfurt and Mureck, 1929.)

SOLUBILITY OF MAGNESIUM SILICO FLUORIDE IN WATER.

(Jatlov and Pinaevskaja, 1938.)

t°	Gms. $MgSiF_6$ per 100 gms. sat. sol.	Solid Phase	t°	Gms. $MgSiF_6$ per 100 gms. sat. sol.	Solid Phase
-0.9	5.0	Ice	20	(1.2399) 23.00(1)	$MgSiF_6 \cdot 6H_2O$
-2.2	10.0	"	40	25.86	"
-3.8	15.0	"	50	28.54	"
-6.0	19.5	" + $MgSiF_6 \cdot 6H_2O$	57	28.66	"
0	20.85	$MgSiF_6 \cdot 6H_2O$	60	30.74	"
+20	23.53	"			

(1) Worthington and Haring, 1931. The figure in parentheses is density of sat. solution.

**SOLUBILITY OF MAGNESIUM SILICO FLUORIDE IN AQUEOUS
SOLUTIONS OF SILICOFLUORIC ACID AT 20°.**

(Jatlov and Pinaevskaja, 1938.)

Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase
H_2SiF_6	$MgSiF_6$		H_2SiF_6	$MgSiF_6$	
0.0	23.53	$MgSiF_6 \cdot 6H_2O$	15.38	8.68	$MgSiF_6 \cdot 6H_2O$
0.97	23.07	"	28.82	2.94	"
1.96	21.84	"	38.30	1.68	"
7.53	16.68	"	46.18	0.20	"

MAGNESIUM Ortho GERMANATE $Mg_3(GeO_4)_2$.

SOLUBILITY IN WATER AND IN AQUEOUS SOLUTIONS AT 26°. (Møller, 1922)

Solvent.	Gms. $Mg_3(GeO_4)_2$ per 100 cc. sat. sol.
Water.....	0.0016
3 vols. H_2O + 2 vols. NH_4OH	0.002
Aq. 10% $(NH_4)_2SO_4$ + excess NH_4OH	0.013

MAGNESIUM IODIDE $MgI_2 \cdot 8H_2O$.

SOLUBILITY IN WATER. (Menschutkin, 1905, 1907.)

The salt was prepared by the action of water upon magnesium iodide dietherate by which the octahydrate and not the hexahydrate is formed. The crystals of this hydrate melt at 43.6°. The solubility determinations were made by the synthetic method.

t°.	Gms. per 100 Gms. Sat. Solution.		Solid Phase.
	$MgI_2 \cdot 6H_2O$	MgI_2	
0	76	54.7	$MgI_2 \cdot 8H_2O$
18	...	59.7 ($d=1.909$)	"
20	81	58.3	"
40	88	63.4	"
43.5 tr.pt.	90.8	65.4	" + $MgI_2 \cdot 6H_2O$
43	89.8	64.7	$MgI_2 \cdot 6H_2O$
80	90.3	65	"
120	90.0	65.4	"
160	91.7	66	"
200	93.4	67.2	"
215	94.3	67.9	"

100 gms. sat. solution of Magnesium Iodide in Liquid Ammonia contain 0.156 gm. MgI_2 at 0°. (Linhard and Stephan, 1933, 1934.)

MAGNESIUM IODIDE ETHERATES, ALCOHOLATES, ACIDATES, etc.

SOLUBILITIES RESPECTIVELY IN ETHER, ALCOHOL AND ACID SOLVENTS AT
VARIOUS TEMPERATURES.

Boris N. Menshutkin. Monograph in the Russian Language entitled "On Etherates and Other Molecular Combinations of Magnesium Bromide and Iodide," St. Petersburg, 1907, pp. 267 + XLVIII. Also published in "Memoirs of the St. Petersburg Polytechnic Institute," vols. 1-7, 1904-07 and in condensed form in vols. 49-67 of the *Zeit. anorg. Chem.*, 1906-09.

Preparation of Material. The dietherate of magnesium iodide, $\text{MgI}_2 \cdot 2\text{C}_4\text{H}_{10}\text{O}$, was prepared by the very gradual addition of iodine to a mixture of magnesium and dry ether. The reaction is not so violent as that which takes place during the preparation of the magnesium bromide dietherate (see p.936). Two liquid layers are present at the end of the reaction and by slight cooling beautiful white needle-like crystals separate from the lower one. The growth of these crystals is also accompanied, as in the case of the magnesium bromide compound, by an evolution of ether droplets. Magnesium iodide dietherate is very hygroscopic, it is less stable than magnesium bromide dietherate, and becomes yellowish even after several hours, and brown after a day, owing probably to separation of iodine. As in the case of the magnesium bromide compound it reacts with very many organic compounds as alcohols, acids, ketones, etc., with liberation of ether and formation of addition products. These latter constitute the material used for the following solubility studies.

Method of Determination of Solubility. The synthetic (sealed tube) method of Alexejeff (*Wied. Ann.*, 1885) was used almost exclusively.

Explanation of Results. As is seen from the following table, the solubility increases much more rapidly with temperature than in the case of magnesium bromide dietherate, especially in the vicinity of the melting point of $\text{MgI}_2 \cdot 2\text{C}_4\text{H}_{10}\text{O}$ under its ethereal solution, which is at 23.6° . At this temperature there appears two layers, the lower one of which may be considered as a solution of ether in dietherate, and the upper one as a solution of the lower layer in ether. By increase of temperature a point is reached, at which both layers are miscible in all proportions (critical point). In the case of magnesium bromide dietherate no such critical point could be obtained. Both layers may be cooled below 23.6° , but only to about $+15^\circ$ since here spontaneous crystallization of the dietherate almost always occurs, and the temperature rises to 23.6° . The great tendency to crystallize is probably due to the difference between the composition of the lower layer and of the saturated solution of the dietherate. The determinations in the vicinity of the critical point were quite difficult to make on account of the considerable opalescence which occurred and also the formation of a white substance, the nature of which was not ascertained. The critical concentration, as determined by means of the law of straight averages of Cailletet and Mathias, was approximately 40.3 per cent $\text{MgI}_2 \cdot 2(\text{C}_2\text{H}_5)_2\text{O}$; the temperature, 38.5° . At concentrations of $\text{MgI}_2 \cdot 2\text{C}_4\text{H}_{10}\text{O}$ greater than 54 per cent, a single liquid is again formed and the solubility curve can be followed up to the melting point of the dietherate at 51° .

SOLUBILITY OF MAGNESIUM IODIDE DIETHERATE IN ETHER AT DIFFERENT TEMPERATURES. (Menschutkin, 1906.)

t°.	Gms. per 100 Gms. Sat. Sol.		Mols. $\text{MgI}_2 \cdot 2(\text{C}_2\text{H}_5)_2\text{O}$ per 100 Mols. Sat. Sol.	Solid Phase.
	$\text{MgI}_2 \cdot 2(\text{C}_2\text{H}_5)_2\text{O} =$	MgI_2		
5.4	2.2	1.45	0.30	$\text{MgI}_2 \cdot 2(\text{C}_2\text{H}_5)_2\text{O}$
11.8	3.7	2.43	0.66	"
15.6	5.3	3.46	0.96	"
18.1	8.3	5.4	1.55	"
20.4	11.6	7.55	2.24	"
22.2	17.3	11.28	3.56	"
23.6	22	14.4	4.67	"

Between these two concentrations of $\text{MgI}_2 \cdot 2(\text{C}_2\text{H}_5)_2\text{O}$ two liquid layers separate (see below).

23.6	54.4	35.5	17.1	"
25	73	47.6	31.9	"
30	82.5	54	42.9	"
35	87	57	53.4	"
40	89.6	58.6	60.4	"
45	93.5	61.2	71.4	"
51.5 m. pt.	100	65.2	100	"

At 23.6° the saturated solution separates into two liquid layers which have the following composition at different temperatures.

t°.	Gms. per 100 Gms. Solution.				
	Lower Layer.		Upper Layer.		
	MgI ₂ ·2(C ₂ H ₅) ₂ O =	MgI ₂ .	MgI ₂ ·2(C ₂ H ₅) ₂ O =	MgI ₂ .	
15	54.4	35.5	20.5	13.4	unstable
20	54.4	35.5	21.5	14.1	"
25	54.4	35.5	22.5	14.7	stable
30	54.4	35.5	23.5	15.4	"
35	54.1	35.3	26	17	"
36	53.5	34.9	27	17.7	"
37	52.2	34.2	28.5	18.7	"
38	50.5	33.1	32	21	"
38.5 crit. temp.	40.3	26.3	40.3	26.3	

MAGNESIUM IODIDE ALCOHOLATES and ANILINATE.

SOLUBILITY OF EACH IN THE RESPECTIVE ALCOHOLS OR ANILINE. (Menschutkin)

$\text{MgI}_2 \cdot 6\text{CH}_3\text{OH}$ in Methyl Alcohol.		$\text{MgI}_2 \cdot 6\text{C}_2\text{H}_5\text{OH}$ in Ethyl Alcohol.		$\text{MgI}_2 \cdot 6\text{C}_6\text{H}_5\text{NH}_2$ in Aniline.		$\text{MgI}_2 \cdot 6(\text{CH}_3)_2\text{CHOH}$ in Dimethyl Carbinol.	
t°.	Gms. $\text{MgI}_2 \cdot 6\text{CH}_3\text{OH}$ per 100 Gms. Sat. Sol.	t°.	Gms. $\text{MgI}_2 \cdot 6\text{C}_2\text{H}_5\text{OH}$ per 100 Gms. Sat. Sol.	t°.	Gms. $\text{MgI}_2 \cdot 6\text{C}_6\text{H}_5\text{NH}_2$ per 100 Gms. Sat. Sol.	t°.	Gms. $\text{MgI}_2 \cdot 6(\text{CH}_3)_2\text{CHOH}$ per 100 Gms. Sat. Sol.
0	49.6	0	21.9	0	3.3	10	57.1
20	52.6	20	33.2	60	3.9	30	60
40	55.3	40	44.4	100	5	50	63.3
60	58.8	60	55.3	130	8.5	70	67
80	60.6	80	65.5	150	17.5	90	71.2
100	63.3	100	74.7	170	38	110	6.2
120	66.2	120	82.7	180	52	120	70.4
140	69.5	130	87.2	188†	64.5	130	84.8
160	73.2	140	93.3	200	65.9*	136	91.7
180	77.1	143	96	210	67.2*	138†	100
200	81.5	146.5†	100	230	69.8*		

* Solid Phase, $\text{MgI}_2 \cdot 4\text{C}_6\text{H}_5\text{NH}_2$.

† M. pt.

‡ Tr. pt.

MAGNESIUM IODIDE COMPOUNDS.

SOLUBILITY OF MAGNESIUM IODIDE COMPOUNDS WITH BENZALDEHYDE, ACETONE, ACETAL, AND ACETIC ACID IN EACH OF THESE LIQUIDS.
(Menschutkin.)

$\text{MgI}_2 \cdot 6\text{C}_6\text{H}_5\text{COH}$ in Benzaldehyde.		$\text{MgI}_2 \cdot 6\text{CH}_3\text{COCH}_3$ in Acetone.		$\text{MgI}_2 \cdot 2\text{CH}_3\text{CH}(\text{OC}_2\text{H}_5)_2$ in Acetal.		$\text{MgI}_2 \cdot 6\text{CH}_3\text{COOH}$ in Acetic Acid.	
t°.	Gms. $\text{MgI}_2 \cdot 6\text{C}_6\text{H}_5\text{COH}$ per 100 Gms. Sat. Sol.	t°.	Gms. $\text{MgI}_2 \cdot 6\text{CH}_3\text{COCH}_3$ per 100 Gms. Sat. Sol.	t°.	Gms. $\text{MgI}_2 \cdot 2\text{CH}_3\text{CH}(\text{OC}_2\text{H}_5)_2$ per 100 Gms. Sat. Sol.	t°.	Gms. $\text{MgI}_2 \cdot 6\text{CH}_3\text{COOH}$ per 100 Gms. Sat. Sol.
0	3.2	0	4.9	20	0.15	20	0.6
20	3.8	30	6.7	60	0.45	40	2
40	5.3	50	8.3	77	0.60	60	5
60	7.7	60	10.2	(Between these two concentrations the mixture separates into two liquid layers.)		70	9.5
80	11	70	15.2			80	18.5
100	18.5	80	28.6			95	42
110	26.5	85	40			105	54.5
120	40	90	59.2	77	92	115	65
125	53	95	80	79	93.7	125	73.8
130	74.5	100	92.5	81	95.5	135	85
136	94.2	105	98.5	83	97.3	140	94.
I 139 m.pt. 100		106.5 m.pt. 100		86 m.pt. 100		142 m.pt. 100	

On account of the properties of these molecular compounds, their great hygroscopicity, etc., the solubility determinations are not strictly accurate in all cases.

SOLUBILITY OF MAGNESIUM IODIDE COMPOUNDS WITH FORMIC AND ACETIC ACID ESTERS IN THE RESPECTIVE ESTERS.
(Menschutkin.)

$\text{MgI}_2 \cdot 6\text{HCOOC}_2\text{H}_5$ in Ethyl Formate.		$\text{MgI}_2 \cdot 6\text{CH}_3\text{COOCH}_3$ in Methyl Acetate.		$\text{MgI}_2 \cdot 6\text{CH}_3\text{COOC}_2\text{H}_5$ in Ethyl Acetate.		$\text{MgI}_2 \cdot 6\text{CH}_3\text{COOC}_3\text{H}_7$ in Propyl Acetate.	
t°.	Gms. $\text{MgI}_2 \cdot 6\text{HCOOC}_2\text{H}_5$ per 100 Gms. Sat. Sol.	t°.	Gms. $\text{MgI}_2 \cdot 6\text{CH}_3\text{COOCH}_3$ per 100 Gms. Sat. Sol.	t°.	Gms. $\text{MgI}_2 \cdot 6\text{CH}_3\text{COOC}_2\text{H}_5$ per 100 Gms. Sat. Sol.	t°.	Gms. $\text{MgI}_2 \cdot 6\text{CH}_3\text{COOC}_3\text{H}_7$ per 100 Gms. Sat. Sol.
0	15.1	0	0.4	0	3.2	0	4.1
10	17.4	60	0.75	20	4.8	20	5.4
20	20.5	90	0.9	40	8.6	30	6.5
30	25	100	1.8	50	13.7	35	7.8
40	31.8	103	2.4	55	21.5	40	10
50	44	(Two layers here.)		60	38	45	46
60	68	103	74.2	65	63.5	50	72.5
70.5 m.pt. 100		110	81.7	70	90.5	55	88.2
		120	98	75	92.7	60	96
		121 m.pt. 100		78.5 m.pt. 100		65 m.pt. 100	

$\text{MgI}_2 \cdot 6\text{CH}_3\text{COO}(\text{iso})\text{C}_4\text{H}_9$
in Isobutyl Acetate.

t°.	Gms. $\text{MgI}_2 \cdot 6\text{CH}_3\text{COO}(\text{iso})\text{C}_4\text{H}_9$ per 100 Gms. Sat. Sol.
0	10.5
20	13.6
40	17.6
60	24.9
70	33.7
80	52
85	89
87.5 m.pt.	100

$\text{MgI}_2 \cdot 6\text{CH}_3\text{COO}(\text{iso})\text{C}_5\text{H}_{11}$
in Isoamyl Acetate.

t°.	Gms. $\text{MgI}_2 \cdot 6\text{CH}_3\text{COO}(\text{iso})\text{C}_5\text{H}_{11}$ per 100 Gms. Sat. Sol.
0	7.7
20	11.5
40	20.9
45	25.5
50	33.2
55	47.8
57.5	63
60 m.pt.	100

SOLUBILITY OF MAGNESIUM IODIDE COMPOUNDS WITH ACETONITRILE, ACETAMIDE AND URETHAN IN THESE LIQUIDS. (Menschutkin.)

MgI₂.6CH₃CN Acetonitrile.			MgI₂.6CH₃CONH₂ in Acetamide.			MgI₂.6NH₄(COO)₂H₄ in Urethan.		
t°.	Gms. MgI ₂ . 6CH ₃ CN per 100 Gms. Sat. Sol.	t°.	Gms. MgI ₂ . 6CH ₃ CONH ₂ per 100 Gms. Sat. Sol.	Solid Phase.	t°.	Gms. MgI ₂ . 6NH ₄ (COO) ₂ H ₄ per 100 Gms. Sat. Sol.	Solid Phase.	t°.
0	37.2	82 m. pt. of acetamide			40	m. pt. of urethan		
30	49.8	70	28	CH ₃ CONH ₂	45	27.5	NH ₄ COOC ₂ H ₅	
50	58.2	58	46.7	"	30	45	"	
70	67.9	49*	56.5	" + MgI ₂ .6CH ₃ CONH ₂	33*	51.8	" + MgI ₂ .NH ₄ (COO) ₂ H ₄	
75	71.7	80	63.4	MgI ₂ .6CH ₃ CONH ₂	40	55	MgI ₂ .NH ₄ (COO) ₂ H ₄	
80	76.5	130	76	"	60	64.7	"	
85	83	160	85.5	"	80	78.8	"	
89	91.3	170	90.8	"	86	92.5	"	
		177†	100	"	87†	100	"	
			* Eutec.			† m. pt.		

MAGNESIUM IODOMERCURATE MgI₂.2HgI₂.7H₂O.

The sat. solution in water at 17.8° has the composition MgI₂.1.29HgI₂.11.06H₂O
(Duboué, 1906)

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MAGNESIUM IODATE Mg(IO₃)₂.4H₂O.

SOLUBILITY OF MAGNESIUM IODATE IN WATER.
(Hill and Moskowitz, 1931.)

The previous determinations of Mylius and Funk, 1897, 1900, are shown to be incomplete.

t°	d of sat. sol.	Gms. Mg(IO ₃) ₂ per 100 gms. sat. sol.	Solid Phase	t°	d of sat. sol.	Gms. Mg(IO ₃) ₂ per 100 gms. sat. sol.	Solid Phase
0	1.026	3.18	Ice + MgIO	40	1.090	10.51	Mg ₄
0	1.034	4.39	MgIO	50	1.115	12.05	"
0	1.049	5.87	"	57.5	—	13.1	" + Mg(IO ₃) ₂
0	1.073	7.79*	"	70	—	14.7*	"
3 trpt.	—	—	" + Mg ₄	90	—	19.6*	"
0	1.047	6.09*	Mg ₄	60	—	13.2	Mg(IO ₃) ₂
0	1.060	6.68*	Mg ₄	70	—	13.3	"
0	1.065	7.29	"	80	—	14.4	"
	1.075	8.55	"	90	—	14.5	"
	1.086	9.83	"				

* Metastable; MgIO = Mg(IO₃)₂.10H₂O; Mg₄ = Mg(IO₃)₂.4H₂O.

Mg MAGNESIUM

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SOLUBILITY OF MAGNESIUM IODATE IN AQUEOUS SOLUTIONS OF MAGNESIUM NITRATE AND VICE VERSA. (Hill and Moskowitz, 1931.)

d. of	gms. per 100 gms. sat. sol.	Solid	d. of	gms. per 100 gms. sat. sol.	Solid
sat. sol.	$\text{Mg}(\text{NO}_3)_2$	Phase	sat. sol.	$\text{Mg}(\text{NO}_3)_2$	Phase

Results at 5°

Results at 25° (con.)

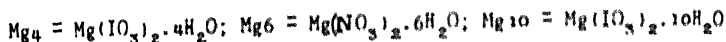
1.034	0.0	4.39	Mg10	1.202	18.48	5.14	Mg4
1.053	2.49	3.93	"	1.261	25.81	4.20	"
1.076	5.45	3.92	"	1.325	33.50	3.25	"
1.105	8.86	4.03	"	1.398	41.00	2.46	" + Mg6
1.149	13.10	4.26	"	1.380	41.60	0.90	Mg6
1.184	17.0	4.55	" + Mg4	1.378	42.03	0.0	"
1.197	18.52	4.44	Mg4				
1.244	24.08	3.95	"				
1.333	34.21	2.82	"				
1.368	38.10	2.39	" + Mg6	1.115	0.0	12.05	Mg4
1.352	39.02	0.46	Mg6	1.141	7.29	9.00	"
1.347	39.25	0.0	"	1.186	15.17	7.31	"
				1.253	24.35	5.58	"
				1.321	32.35	4.36	"
				1.368	38.82	3.57	"

Results at 50°

Results at 25°

IO

1.075	0.0	8.55	Mg4	—	74.41	1.13	" + Mg6
1.089	3.49	7.35	"	—	45.27	1.52	Mg6
1.116	7.31	6.66	"	—	46.09	0.0	"
1.171	14.60	5.66	"				



SOLUBILITY OF MAGNESIUM IODATE IN AQUEOUS SOLUTIONS OF SODIUM IODATE AND VICE VERSA. (Hill and Ricci, 1931.)

d. of	gms. per 100 gms. sat. sol.	Solid	d. of	gms. per 100 gms. sat. sol.	Solid
sat. sol.	NaIO_3	Phase	sat. sol.	NaIO_3	Phase

Results at 5°

Results at 25° (con.)

1.038	0.0	4.37	Mg10	1.119	7.77	4.76	$\text{NaIO}_3 \cdot \text{H}_2\text{O}$
1.047	1.45	3.74	"	1.102	7.94	2.99	"
1.055	2.53	3.33	" + Na5	1.081	8.30	1.18	"
1.043	2.68	2.19	Na5	1.076	8.57	0.00	"
1.028	3.28	0.0	"				

Results at 50°

Results at 25°

1.078	0.0	8.54	Mg4	—	0.0	11.97	Mg4
1.091	2.80	7.24	"	—	4.59	9.95	"
1.113	6.16	6.05	"	—	8.94	8.41	"
1.125	7.49	5.86	" + $\text{NaIO}_3 \cdot \text{H}_2\text{O}$	—	11.97	7.67	" + $\text{NaIO}_3 \cdot \text{H}_2\text{O}$
1.128	7.66	5.73	"	—	12.42	4.93	$\text{NaIO}_3 \cdot \text{H}_2\text{O}$
1.139	8.79	5.57	" + NaIO_3	—	13.05	3.73	"
1.134	8.74	5.42	NaIO_3	—	13.26	3.05	"
1.121	7.52	5.40	$\text{NaIO}_3 \cdot \text{H}_2\text{O}$	—	13.37	2.64	"
1.122	7.50	5.33	"	—	13.54	1.55	"
				—	13.99	0.00	"



MAGNESIUM NITRITE $\text{Mg}(\text{NO}_2)_2 \cdot 6\text{H}_2\text{O}$

MAGNESIUM

SOLUBILITY OF MAGNESIUM NITRITE IN WATER DETERMINED
BY THE SYNTHETIC METHOD.

(Bureau, 1936, 1937.)

t°	Oms. $\text{Mg}(\text{NO}_2)_2$ per 100 gms. sat. sol.	Solid Phase	t°	Oms. $\text{Mg}(\text{NO}_2)_2$ per 100 gms. sat. sol.	Solid Phase
-3.25	7.04	Ice	-1.65	31.75	Mg9
-14.03	17.25	"	-10.5 tr.pt.	38.6	" + Mg6
-21.15 Eutec.	23.2	" + Mg9	16.35	40.9	Mg6
-16.15	24.4	Mg9	25.65	47.0	"
-12.15	26.6	"	29.5 tr.pt.	52.0	" + Mg3
-2.15	30.25	"			

Mg3 = $\text{Mg}(\text{NO}_3)_2 \cdot 3\text{H}_2\text{O}$; Mg6 = $\text{Mg}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$; Mg9 = $\text{Mg}(\text{NO}_3)_2 \cdot 9\text{H}_2\text{O}$.

At temperatures above the tr.pt. 29.5° hydrolysis of the salt occurs with rapid decomposition of the solution.

MAGNESIUM NITRATE $\text{Mg}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$.

SOLUBILITY OF MAGNESIUM NITRATE IN WATER.

(Sleverts and Petzold, 1932; Ewing, Brander, Slichter and Griesinger, 1933.)

The closely agreeing results of the above investigators made by the freezing-point and direct solubility methods, were plotted and the following values taken from the average curve.

t°	d. of sat. sol.	Oms. $\text{Mg}(\text{NO}_3)_2$ per 100 gms. sat. sol.	Solid Phase	t°	d. of sat. sol.	Oms. $\text{Mg}(\text{NO}_3)_2$ per 100 gms. sat. sol.	Solid Phase
-5.0	1.092	12.0	Ice	85	1.484	53.3	Mg6
-10.0	1.150	18.5	"	88	1.515	55.5	"
-15.0	1.202	22.7	"	89.5 m.pt.	—	58.0	"
-20	1.238	26.5	"	88	—	60.0	"
-25	1.268	29.5	"	85	—	61.5	"
-30	1.295	31.5	"	80	—	63.2	"
-34.1	—	33.4*	"	70	—	65.5	"
-31.6	1.302	32.3	" + Mg9	60	—	66.3	"
-30	—	32.5	Mg9	55.6 tr.pt.	—	67.4	" + Mg2
-25	—	33.7	"	52.5	—	68.0*	"
-20	—	35.3	"	40.5	—	69.0*	"
-15 tr.pt.	—	37.0	" + Mg6	60	—	67.5	Mg2
-33	—	35.5*	Mg6	70	—	68.5	"
-23	—	36.5*	"	80	—	69.5	"
-8	—	37.5	"	100	—	71.7	"
+1.0	1.365	38.5	"	120	—	75.4	"
15	1.379	40.4	"	125	—	77.0	"
25	1.388	42.1	"	129 m.pt.	—	80.0	"
35	1.399	43.2	"	127.7 tr.pt.	—	81.8	" + $\text{Mg}(\text{NO}_3)_2$
40	1.405	44.1	"	130	—	82.0	$\text{Mg}(\text{NO}_3)_2$
50	1.422	45.8	"	140	—	82.4	"
60	1.445	47.7	"	160	—	83.8	"
75	1.454	50.3	"	186	—	84.6	"
80	1.468	51.5	"				

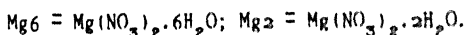
Mg2 = $\text{Mg}(\text{NO}_3)_2 \cdot 2\text{H}_2\text{O}$; Mg6 = $\text{Mg}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$; Mg9 = $\text{Mg}(\text{NO}_3)_2 \cdot 9\text{H}_2\text{O}$.

* = Metastable.

SOLUBILITY OF MAGNESIUM NITRATE IN AQUEOUS SOLUTIONS
OF NITRIC ACID AT 25°.

(Ewing and Klinger, 1933.)

Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase
HNO ₃	Mg(NO ₃) ₂		HNO ₃	Mg(NO ₃) ₂		HNO ₃	Mg(NO ₃) ₂	
0.0	42.5	Mg6	56.7	16.5	Mg6	68.5	19.0	Mg2
12.6	37.3	"	54.6	20.2	"	77.0	13.0	"
18.5	28.6	"	40.9	34.3	"	84.4	9.4	"
28.1	22.1	"	39.6	36.0	"	89.7	6.2	"
36.7	17.1	"	41.0	36.7	Mg2	91.0	4.7	Mg(NO ₃) ₂
45.4	13.2	"	54.8	27.6	"	93.9	3.8	"
55.4	11.5	"	58.4	25.2	"	99.6	0.2	"



Results for this system at 20° and for concentrations of HNO₃ up to 59.38 percent are given by Nalquori, 1938.

NO

MAGNESIUM NITRATE $\text{Mg}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$.

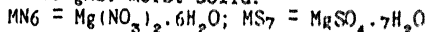
SOLUBILITY OF MAGNESIUM NITRATE IN AQUEOUS SOLUTIONS
OF MAGNESIUM SULFATE AND VICE VERSA AT 0°.

(Benrath and Benrath, 1920.)

d. of sat. sol.	Gms. per 100 gms. sat. sol.		Solid Phase	d. of sat. sol.	Gms. per 100 gms. sat. sol.		Solid Phase
	MgSO ₄	Mg(NO ₃) ₂			MgSO ₄	Mg(NO ₃) ₂	
1.368	0.0	38.58	MN6	1.230	6.41	17.82	MS7
1.368	0.99	37.65	"	1.216	10.81	10.81	"
1.368	1.38	37.03(1)	" + MS7	1.214	11.98	9.17	"
1.369	1.48	36.99	"	1.222	16.58	3.94	"
1.370	1.56	37.04	"	1.224	17.98	2.73	"
1.372	1.62	36.80(2)	"	1.234	19.70	1.09	"
1.290	2.52	28.69	MS7	1.236	20.82	0.0	"

(1) The solid phase contained 11.99 gm. MgSO₄ + 42.5 gm. Mg(NO₃)₂ per 100 gms. moist solid.

(2) The solid phase contained 8.36 gm. MgSO₄ + 46.99 gm. Mg(NO₃)₂ per 100 gms. moist solid.



SOLUBILITY OF MAGNESIUM NITRATE IN AQUEOUS SOLUTIONS
OF MAGNESIUM SULFATE AND VICE VERSA AT 25°.

(Benrath, 1928, 1929.)

d. of sat. sol.	Gms. per 100 MgSO ₄	gms. sat. sol. Mg(NO ₃) ₂	Solid Phase	d. of sat. sol.	Gms. per 100 MgSO ₄	gms. sat. sol. Mg(NO ₃) ₂	Solid Phase
1.397	0.0	42.89	MN6	1.316	5.50	28.49	MS7
1.396	0.99	41.10	"	1.277	10.00	19.06	"
1.399	1.77	40.65	"	1.271	15.90	11.25	"
1.401	2.28	40.05	"	1.371	16.36	10.71	"
1.403	2.85	39.79	" + MS7	1.280	20.03	6.68	"
1.345	3.90	33.55	MS7	1.304	26.68	0.0	"

MN6 = Mg(NO₃)₂·6H₂O; MS7 = MgSO₄·7H₂O.

Previous results at 25°, differing slightly from the above, are given by Jackman and Browne, 1922.

Additional determinations for the system Mg(NO₃)₂ + MgSO₄ + H₂O at 25°, 35°, 41°, 50° and 60° are given by Schröder, 1929; Results at 74.6° by Schröder, 1929a, 1929b; Results at 15°, 50° and 97° by Benrath, 1928, 1929; and Results at 99.5° by Benrath and Benrath, 1930.

The above named investigators also give very complete data for equilibrium in the reciprocal salt pair.

$\text{Mg(NO}_3)_2 + \text{K}_2\text{SO}_4 \rightleftharpoons \text{MgSO}_4 + \text{K}_2(\text{NO}_3)_2$ at the several temperatures indicated above.

NO

SOLUBILITY OF MAGNESIUM NITRATE IN AQUEOUS SOLUTIONS
OF MANGANESE NITRATE AND VICE VERSA AT 20°.

(Dicapua, 1929.)

Gms. per 100 Mn(NO ₃) ₂	gms. sat. sol. Mg(NO ₃) ₂	Solid Phase	Gms. per 100 Mn(NO ₃) ₂	gms. sat. sol. Mg(NO ₃) ₂	Solid Phase
0.0	43.68	Mg(NO ₃) ₂ ·6H ₂ O	27.40	29.0	MgSO ₄ ·6H ₂ O
2.88	41.25	"	28.36	27.78	"
7.15	38.00	"	29.15	26.50	" + MnSO ₄ ·5H ₂ O
9.90	37.15	"	32.0	24.35	MnSO ₄ ·5H ₂ O
12.41	35.40	"	39.92	16.17	"
18.85	31.60	"	44.30	10.05	"
31.30	20.60	"	49.76	6.15	"
26.25	29.92	"	56.81	0.0	"

Mg MAGNESIUM
MAGNESIUM NITRATE

980

SOLUBILITY OF MAGNESIUM NITRATE IN AQUEOUS SOLUTIONS
OF SODIUM NITRATE AND VICE VERSA AT 25°.

(Jackman and Browne, 1922; Benrath, 1928, 1929; Sieverts and Muller, 1930.)

The results of the above named investigators were plotted and the following values read from the average curve.

Gms. per 100 gms. sat. solution		Solid Phase	Gms. per 100 gms. sat. solution		Solid Phase
Mg(NO ₃) ₂	NaNO ₃		Mg(NO ₃) ₂	NaNO ₃	
42.5	0.0	Mg(NO ₃) ₂ · 6H ₂ O	32.0	12.5	NaNO ₃
41.2	2.0	"	24.0	20.0	"
40.2	4.0	"	16.0	28.8	"
39.4	6.0	"	8.0	38.5	"
38.6	8.0	"	4.0	43.2	"
38.2	9.0	" + NaNO ₃	0.0	48.0	"

SIMULTANEOUS SOLUBILITY OF MAGNESIUM NITRATE AND SODIUM NITRATE
IN WATER AT SEVERAL TEMPERATURES.

NO

t°	d. of sat. sol.	Gms. per 100 gms. sat. solution		Solid Phase
		Mg(NO ₃) ₂	NaNO ₃	
0	--	35.17	6.59 (5)	Mg(NO ₃) ₂ · 6H ₂ O + NaNO ₃
15	1.412	36.62	8.43 (1)	"
"	1.414	36.5	7.7 (2)	"
25	--	38.25	9.22 (3)	"
"	--	38.01	7.72 (5)	"
"	1.441	37.99	9.28 (1)	"
"	1.427	37.8	8.2 (2)	"
50	1.488	42.40	7.92 (1)	"
"	1.463	41.8	8.9 (2)	"
75	1.521	47.9	8.6 (4)	"
"	1.721	66.4	5.5 (4)	Mg(NO ₃) ₂ · 2H ₂ O + NaNO ₃
110	--	69.4	10.2 (4)	"

(1) = Benrath, 1928, 1929; (2) Sieverts and Muller, 1930; (3) Jackman and Browne, 1922; (4) Sieverts and Muller, 1931; (5) Schroder, 1930.

MAGNESIUM Ammonium NITRATE Mg(NO₃)₂ · 2NH₄NO₃.

100 gms. H₂O dissolve 10 gms. Mg(NO₃)₂ · 2NH₄NO₃ at 12.5°. (Foucaud)

MAGNESIUM Neodymium NITRATE $3\text{Mg}(\text{NO}_3)_2 \cdot 2\text{Nd}(\text{NO}_3)_3 \cdot 24\text{H}_2\text{O}$.

SOLUBILITY OF MAGNESIUM NEODYMIUM NITRATE IN WATER AND IN
AQUEOUS SOLUTIONS OF NITRIC ACID AND OF MAGNESIUM NITRATE.
(Friend, 1930.)

Solubility in Water		Solubility in Aqueous HNO_3 and $\text{Mg}(\text{NO}_3)_2$		
t°	Gms. $\text{Mg}(\text{NO}_3)_2 \cdot 2\text{Nd}(\text{NO}_3)_3 \cdot 24\text{H}_2\text{O}$ per 100 gms. sat. sol.	Aqueous Solvent	t°	
			Gms. $\text{Mg}(\text{NO}_3)_2 \cdot 2\text{Nd}(\text{NO}_3)_3 \cdot 24\text{H}_2\text{O}$ per 100 gms. sat. sol.	
0.4	60.42	1.0 Normal HNO_3	0.6	57.21
0.6	60.84	" " "	14.4	d=1.499 60.25
4.4	61.92	" " "	24.2	63.06
14.2	64.0	" " "	77.2	78.26
17.0	63.81	2.2 Normal HNO_3	15.2	54.49
27.2	67.28	" " "	50.2	63.14
40.6	70.72	5.2 Normal HNO_3	14.8	42.01
48.8	72.50	" " "	24.8	45.84
65.4	77.64	" " "	74.0	64.40
75.6	81.07	11.25 Normal HNO_3	14.8	d=1.357 5.64
87.0	84.35	" " "	49.0	30.98
90.6	86.89	" " "	78.0	62.47
109.0m.pt.	100.00	0.7 Normal $\text{Mg}(\text{NO}_3)_2$	24.8	59.23
		1.77 " "	24.4	50.31
		saturated "	24.2	2.92

MAGNESIUM NITRATE Methyl and Ethyl Alcoholates

SOLUBILITY OF EACH RESPECTIVELY IN METHYL AND ETHYL ALCOHOL.
(Lloyd, Brown, Glynn, Bonnell and Jones, 1928.)

Results for $\text{Mg}(\text{NO}_3)_2 \cdot 6\text{CH}_3\text{OH}$			Results for $\text{Mg}(\text{NO}_3)_2 \cdot 6\text{C}_2\text{H}_5\text{OH}$		
t°	Gms. $\text{Mg}(\text{NO}_3)_2$ per 100 gms. CH_3OH	Solid Phase	t°	Gms. $\text{Mg}(\text{NO}_3)_2$ per 100 gms. $\text{C}_2\text{H}_5\text{OH}$	Solid Phase
10	15.7	$\text{Mg}(\text{NO}_3)_2 \cdot 6\text{CH}_3\text{OH}$	0	1.47	$\text{Mg}(\text{NO}_3)_2 \cdot 6\text{C}_2\text{H}_5\text{OH}$
20	17.3	"	20	3.07	"
30	20.9	"	30	5.39	"
40	23.3	"	40	10.86	"
50	26.9	"	50	16.53	"
60	35.0	"	60	24.23	"
			70	34.02	$\text{Mg}(\text{NO}_3)_2$
			80	32.63	"

MAGNESIUM OXIDE MgO

SOLUBILITY OF MAGNESIUM OXIDE IN AQUEOUS SOLUTIONS
OF MAGNESIUM CHLORIDE AT 30° .
(Lukens, 1932.)

Magnesium oxide dissolves in aqueous MgCl_2 solutions with subsequent precipitation of a compound of the composition $5\text{MgO} \cdot \text{MgCl}_2 \cdot x\text{H}_2\text{O}$. The rate of the reaction is influenced by the previous heat treatment of the MgO and the temperature at which the reaction occurs. The compound initially precipitated is transformed by continued contact with MgCl_2 solutions of Sp. Gr. above 1.16, to a new compound, $5\text{MgO} \cdot \text{MgCl}_2 \cdot y\text{H}_2\text{O}$, containing a different amount of water. The water content, x and y , of these compounds could not be determined.

In previous studies of this system at 25° and at 50° by Maeda and Yamane, 1928, the authors reported the composition of the compound

SOLUBILITY OF MAGNESIUM OXIDE IN AQUEOUS SOLUTIONS CONTAINING SODIUM CHLORIDE AND SODIUM HYDROXIDE.

(Maigret, 1905.)

Gms. NaCl per Liter.	Gms. MgO per Liter Solution with Added:	
	0.8 g. NaOH per Liter.	4.0 g. NaOH per Liter.
125	0.07	0.03
140	0.045	...
160	none	none

MAGNESIUM HYDROXIDE $\text{Mg}(\text{OH})_2$.

SOLUBILITY OF MAGNESIUM HYDROXIDE IN WATER AT 18°.

A saturated solution prepared by agitating freshly ignited Mg O with conductivity water for 4 hours, taking greatest care to exclude CO_2 , was found to contain 0.016 gm. Mg O per liter. This corresponds to 0.397 millimols Mg O or $\text{Mg}(\text{OH})_2$ per liter. By conductometric measurements the solubility was found to be 0.348 millimols per liter and by conductivity titration, 0.39 millimols per liter. The value 0.2 millimol, of Kohbranch is considered to be too low.

(Remy and Kuhlmann, 1924.)

According to Gjalbaek, 1925, magnesium hydroxide exists in two well defined modifications of which the more easily soluble is the labil form and the more difficultly soluble is the stable form. The labil form is obtained by precipitating magnesium salts with bases, by hydration of magnesium oxide and by replacement between metallic magnesium and water. The stable magnesium hydroxide is formed from the labil. The change (recrystallization) goes quickly at high magnesium concentrations and slower at lower concentrations.

The following comparative results are reported. Temp. 18°.

Method.	Minimum Solubility (stable.)	Maximum Solubility (labil).
Direct solubility determination.....	$2.2 \cdot 10^{-4}$	$6.5 \cdot 10^{-4}$
$\text{Mg}^{++} + 2\text{NH}_4\text{OH} \rightleftharpoons \text{Mg}(\text{OH})_2 + 2\text{NH}_4^+$	$1.9 \cdot 10^{-4}$	$5.5 \cdot 10^{-4}$
Conductivity method.....	$(1.35 \cdot 10^{-4})$	$4.6 \cdot 10^{-4}$
Electrometric method.....	$1.6 \cdot 10^{-4}$	$7.0 \cdot 10^{-4}$

More recent determinations gave 0.000214 gm. mol. MgO per liter at 29° (Busch, 1927) and 0.00046 gm. Mol. $\text{Mg}(\text{OH})_2$ per liter at 25°. Whitby, 1933. This author also gives results for the solubility of $\text{Mg}(\text{OH})_2$ in aqueous solutions of KOH, KCl, KBr, KI and K_2SO_4 at 25°.

SOLUBILITY OF MAGNESIUM HYDROXIDE IN WATER AT HIGH TEMPERATURES.

(Travers and Nouvel, 1929.)

Crystalline $\text{Mg}(\text{OH})_2$ was used and the determinations were made in a copper flask or copper lined autoclave at the higher pressures. The dissolved magnesia was determined by the electrometric method (hydrogen electrode) and also by direct titration using phenol red as indicator and operating in an atmosphere free of CO_2 .

t°	Gm. Mol. $\text{Mg}(\text{OH})_2$ per liter sat. sol.	t°	Gm. Mol. $\text{Mg}(\text{OH})_2$ per liter sat. sol.
18	0.000168	110	0.000074
35	0.000169	142	0.000042
45	0.000150	150	0.000037
70-75	0.000118	158	0.000031
100	0.000072	178	0.000000

The presence of NaCl and of Na_2SO_4 increase the solubility. Thus in an aqueous solution of 1.0 gm. Na_2SO_4 per 100cc, the solubility of the $\text{Mg}(\text{OH})_2$ is 0.000238 gm. mols. per liter at 110° and 0.000142 gm. mols. at 160°.

SOLUBILITY OF MAGNESIUM HYDROXIDE IN AQUEOUS SOLUTIONS OF AMMONIUM CHLORIDE AND OF AMMONIUM NITRATE AT 29°.

(Herz and Muhs — Z. anorg. Ch. 38, 140, '04.)

NOTE. — Pure $\text{Mg}(\text{OH})_2$ was prepared and an excess shaken with solutions of ammonium chloride and of ammonium nitrate of different concentrations.

Concentration of NH_4Cl or of NH_4NO_3 (Normal.)	Acid Required for Liberated NH_4OH in 25 cc. (Normal.)	Normality of:		Grams per Liter.	
		$\text{Mg}(\text{OH})_2$.	NH_4Cl .	$\text{Mg}(\text{OH})_2$.	NH_4Cl .
.7 (NH_4Cl)	0.09835	0.156	0.388	4.55	20.86
0.466 "	0.1108	0.108	0.250	3.15	13.39
0.35 "	0.09835	0.089	0.172	2.60	9.21
0.233 "	0.1108	0.0638	0.106	1.86	5.67
0.175 "	0.1108	0.049	0.0771	1.43	4.13
0.35 (NH_4NO_3)	0.1108	0.0833	0.1834	2.43	14.69 (NH_4NO_3)
0.175 "	0.1108	0.0495	0.076	1.45	6.09 "

SOLUBILITY OF MAGNESIUM HYDROXIDE IN AQUEOUS SOLUTIONS OF AMMONIA AND AMMONIUM CHLORIDE AT 18°.

(Fredholm, 1934.)

Paraffined flasks were used and CO_2 carefully excluded. In order to approach equilibrium from both sides a part of the mixtures were prepared by adding NH_3 and NH_4Cl to aqueous MgCl_2 solutions and the others (last three in table) by adding an excess of carefully prepared $\text{Mg}(\text{OH})_2$ to NH_4Cl solutions. The solutions were shaken from 2 to 8 days. The clear saturated solutions were analyzed for Mg , NH_3 and NH_4^+ .

OH

Gm. Mols. per liter			Gm. Mols. per liter		
NH_3	NH_4^+	Mg	NH_3	NH_4^+	Mg
0.0637	0.0409	0.0317	0.0357	0.0167	0.0175
0.0369	0.0228	0.0338	0.1024	0.0952	0.0512
0.0308	0.0220	0.0410	0.0577	0.0411	0.0289
0.0760	0.0285	0.0120	0.0391	0.0201	0.0196

MAGNESIUM PHOSPHATE $\text{MgHPO}_4 \cdot 3\text{H}_2\text{O}$.

SOLUBILITY OF MAGNESIUM PHOSPHATE IN AQUEOUS SOLUTIONS OF PHOSPHORIC ACID AT 25°. (Cameron and Bell, 1907.)

PO

The mixtures were constantly agitated for two months and the clear solutions analyzed for magnesia and phosphoric acid.

d_{25} of Sat. Sol.	Gms. per Liter.		Solid Phase.	d_{25} of Sat. Sol.	Gms. per Liter.		Solid Phase.
	MgO .	P_2O_5 .			MgO .	P_2O_5 .	
...	0.207	0.486	$\text{MgHPO}_4 \cdot 3\text{H}_2\text{O}$	...	109.5	439	$\text{MgHPO}_4 \cdot 3\text{H}_2\text{O}$
..	0.280	0.732	"	1.470	122.6	498	"
...	0.553	1.917	"	...	129.9	540.5	"
...	1.438	4.85	"	...	140	584	"
1.006	2.23	7.35	"	1.595	146.8	623.3	"
1.017	4.73	16.84	"	...	147.3	625.9	"
1.042	11.19	38.59	"	...	150.3	645.8	"
1.069	17.33	61.21	"	...	155.5	680.7	"
1.109	26.09	93.09	"	...	160	700	"
1.144	37.40	130.7	"	1.626	87.1	779.6	$\text{MgH}_2(\text{PO}_4)_2 \cdot \text{XH}_2\text{O}$
1.285	75.5	281.8	"	1.644	77.1	800.6	$\text{MgH}_2(\text{PO}_4)_2 \cdot \text{XH}_2\text{O}$
			"	1.654	70.6	835.1	"

MAGNESIUM (Hypo) PHOSPHATE $\text{Mg}_2\text{P}_2\text{O}_6 \cdot 12\text{H}_2\text{O}$.

One liter of water dissolves 0.066 gm. hypophosphate.

(Salzer, 1886.)

One liter of water dissolves 5 gms. magnesium hydrogen hypophosphate,

 $\text{MgH}_2\text{P}_2\text{O}_6 \cdot 4\text{H}_2\text{O}$.

(Salzer.)

SOLUBILITY IN WATER AND SALT SOLUTIONS.
(Bube, 1910.)

The solutions were saturated in 7-16 liter flasks. The stirrer was introduced through a mercury sealed connection, in order to prevent loss of moisture or ammonia during the long periods required for saturation. Great care was exercised to eliminate errors of manipulation. Large volumes of the saturated solutions were used for analysis. In the cases where equilibrium was approached from above (designated by *, in table below) the mixtures were heated to about 90°, and then cooled while being continually stirred for 4-5 hours at 50°, and then in a thermostat at 25° for the remaining period shown.

Solvent.	t°.	Time for Saturation.	Gms. per 100 Gms. Sat. Sol.			Solid Phase.
			Mg.	P ₂ O ₅ .	NH ₃ .	
Water	25°	69 hrs.	0.0808	0.0905	...	Mixed Hydrates
"	25	9 days	0.0867	0.0992	...	"
"	25	14 "	0.1352	0.1333	0.1301	"
"	22.7	17 hrs.*	0.1076	0.1084	0.1040	Monohydrate
2% NH ₄ Cl	25	20 days	0.3129	0.3057	...	Mixed Hydrates
$\frac{1}{3.2}\%$ NH ₄ Cl + 1% NH ₃	25.2	16 hrs.*	0.0240	0.02025	...	Monohydrate
0.2 Mol. MgCl ₂ per liter H ₂ O	25	27 days	...	0.0206	...	Mixed Hydrates
0.2 " " " "	25.2	16 hrs.*	...	0.0512	...	Monohydrate
$\frac{1}{3.2}\%$ Mol. (NH ₄) ₂ HPO ₄ per liter H ₂ O	24.25	...	0.1220	...	...	"

SOLUBILITY OF AMMONIUM MAGNESIUM PHOSPHATE IN SEVERAL SOLVENTS.
(Wenger, 1911.)Gms. NH₄MgPO₄ per 100 Gms. Solvent in:

t°	Water.	Aq. 5% NH ₄ NO ₃ .	Aq. 5% NH ₄ Cl.	Mixture of 1 Pt. NH ₃ (d=0.96) + 1 Pts. H ₂ O.	Aq. 5% NH ₄ Cl + NH ₃ per 100.	Aq. 10% NH ₄ Cl + 4 NH ₃ per 100.
0	0.023	0.110	0.060	0.0087	...	...
20	0.052	0.046	0.105	0.0098	0.0165	0.0541
30	...	0.054	0.113	...	...	...
40	0.036	0.064	0.071	0.0136	...	...
56	0.030	0.072	0.093	0.0153	...	...
60	0.040	0.085	0.173	0.0174	0.0274	0.0731
70	0.016	0.083	0.124	0.0178	...	...
80	0.019	0.101	0.191	0.0145	...	...

SOLUBILITY OF MAGNESIUM AMMONIUM PHOSPHATE IN AQUEOUS
SALT SOLUTIONS AT ABOUT 18°.

(Haljaroff and Matkewitsch, 1884.)

An excess of $\text{MgNH}_4\text{PO}_4 \cdot 6\text{H}_2\text{O}$, made from MgCl_2 , was shaken at room temperature with each of the salt solutions and from time to time the content of phosphate was determined. Equilibrium was reached after a short (?) time. The content of magnesium ammonium phosphate was determined by titration with 0.1 N HCl using methyl orange as indicator.

Conc. of Aq. Salt solution
in gms. per 100 ccGms. MgNH_4PO_4 per liter sat. solution in aqueous:

	NaCl.	NH ₄ NO ₃ .	Na ₂ SO ₄ .	NH ₄ Cl	(NH ₄) ₂ SO ₄ .	(NH ₄) ₂ P ₂ O ₄ .
0.625	0.1067	---	0.1272	0.1092	--	0.1505
1.25	0.1191	0.1186	0.1512	0.1355	0.1415	0.3208
2.50	0.1459	0.1376	0.1774	0.1882	0.1876	0.4688
5.00	0.1552	0.1668	0.1894	0.2205	0.2493	0.7690
7.50	--	0.1919	--	0.2515	--	--
10.00	0.1625	0.2042	0.2482	0.2725	0.3535	--

MAGNESIUM SULFITE $\text{MgSO}_3 \cdot 6\text{H}_2\text{O}$.

MAGNESIUM Mg

SOLUBILITY OF MAGNESIUM SULFITE IN WATER.

(Hagisawa, 1974.)

t°	Gms. MgSO_3 per 100 gms. sat. sol.	Solid Phase	t°	Gms. MgSO_3 per 100 gms. sat. sol.	Solid Phase
0	0.338	$\text{MgSO}_3 \cdot 6\text{H}_2\text{O}$	65	0.720	$\text{MgSO}_3 \cdot 3\text{H}_2\text{O}$
15	0.497	"	75	0.664	"
25	0.646	"	85	0.623	"
35	0.846	"	98	0.615	"
40 tr.pt.	—	" + $\text{MgSO}_3 \cdot 3\text{H}_2\text{O}$	45	1.116*	$\text{MgSO}_3 \cdot 6\text{H}_2\text{O}$
42	0.937	$\text{MgSO}_4 \cdot 3\text{H}_2\text{O}$	55	1.465*	"
46	0.897	"	57.5	1.688*	"
50	0.844	"	62.5	1.950*	"
55	0.817	"	38	1.034*	$\text{MgSO}_3 \cdot 3\text{H}_2\text{O}$

* Metastable

MAGNESIUM SULFATE $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$.

SOLUBILITY OF MAGNESIUM SULFATE IN WATER.

S(1)

This system is complicated by the great range of temperature over which the hexa and penta(?) hydrates exist in metastable equilibrium. Of the large number of determinations which have been made, those of de Coppet, 1872 (ice curve); Cottrell et.al. 1901 (Eutectic); Küpper, 1927; Schroder, 1929; Ting and McCabe, 1934; Robson, 1927; Froehlich, 1929; and Smits, Rinse and Lowwe-Kooymans, 1928 were plotted and the following values read from the average curve.

t°	Gms. MgSO_4 per 100 gms. sat. sol.	Solid Phase	t°	Gms. MgSO_4 per 100 gms. sat. sol.	Solid Phase
-2.5	12.0	Ice	69 tr.pt.	37.1	$\text{MgSO}_4 \cdot 6\text{H}_2\text{O} + \text{MgSO}_4 \cdot \text{H}_2\text{O}$
-3.5 Eutec.	17.0 (?)	" + $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$	70	37.3*	$\text{MgSO}_4 \cdot 6\text{H}_2\text{O}$
-4.0	19.0*	" + $\text{MgSO}_4 \cdot 6\text{H}_2\text{O}$	80 tr.pt.	39.3*	" + $\text{MgSO}_4 \cdot 5\text{H}_2\text{O}$ (or $4\text{H}_2\text{O}$)
0	18.0 (?)	$\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$	85	40.2*	$\text{MgSO}_4 \cdot 6\text{H}_2\text{O}$
0	20.5*	$\text{MgSO}_4 \cdot 6\text{H}_2\text{O}$	90	41.2*	"
10	22.0 (?)	$\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$	95	42.0*	"
10	23.6*	$\text{MgSO}_4 \cdot 6\text{H}_2\text{O}$	100	42.9*	"
20	25.2	$\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$	85	39.3*	$\text{MgSO}_4 \cdot 5\text{H}_2\text{O}$ (or $4\text{H}_2\text{O}$)
20	28.3*	$\text{MgSO}_4 \cdot 6\text{H}_2\text{O}$	90	39.6*	"
25	26.7	$\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$	95	40.0*	"
25	27.6*	$\text{MgSO}_4 \cdot 6\text{H}_2\text{O}$	100	40.5*	"
30	28.0	$\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$	80	35.8	$\text{MgSO}_4 \cdot \text{H}_2\text{O}$
30	28.8*	$\text{MgSO}_4 \cdot 6\text{H}_2\text{O}$	90	34.6	"
35	29.3	$\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$	100	33.5	"
35	30.0*	$\text{MgSO}_4 \cdot 6\text{H}_2\text{O}$	120	30.0	"
40	30.8	$\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$	140	24.0	"
40	31.2*	$\text{MgSO}_4 \cdot 6\text{H}_2\text{O}$	160	13.0	"
40	32.3	$\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$	170	8.0	"
48 tr.pt.	33.0	" + $\text{MgSO}_4 \cdot 6\text{H}_2\text{O}$	180	5.0	"
50	33.4	$\text{MgSO}_4 \cdot 6\text{H}_2\text{O}$	190	2.5	"
55	34.3	"	200	1.5	"
60	35.3	"	220	0.8	"
65	36.3	"	240	0.5	"

* Metastable

Mg MAGNESIUM

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MAGNESIUM Oxy SULFATE $\text{MgSO}_4 \cdot 3\text{MgO} \cdot 11\text{H}_2\text{O}$.
(Delyon, 1936.)

Aqueous solutions of MgSO_4 containing more than 500 gms. per liter dissolve MgO with formation of the oxy sulfate, $\text{MgSO}_4 \cdot 3\text{MgO} \cdot 11\text{H}_2\text{O}$. The author studied the influence of the mode of preparation of the MgO , the concentration of MgSO_4 and the temperature upon this reaction. The results show the amount of MgO dissolved under given conditions. For example it was found that one liter of an aqueous solution containing 500 gms. MgSO_4 , dissolves 4.2 gms. MgO at 60° .

MAGNESIUM SULFATE $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$.

SOLUBILITY OF MAGNESIUM SULFATE IN AQUEOUS SOLUTIONS OF SULFURIC ACID AT 12.6° . (Montemartini and Losana, 1928.)

d. of sat. sol.	Gms. per 100 gms. sat. sol.		Solid Phase	d. of sat. sol.	Gms. per 100 gms. sat. sol.		Solid Phase
	H_2SO_4	MgSO_4			H_2SO_4	MgSO_4	
1.2666	0.0	24.33	$\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$	1.4390	33.74	15.16	1.1.3
1.2729	8.64	19.25	"	1.4431	40.94	11.12	" + 1.3
1.2861	15.78	16.05	"	1.4906	53.01	4.25	1.3
1.3267	24.28	12.23	" + $\text{MgSO}_4 \cdot \text{H}_2\text{O}$	1.5688	59.10	1.50	" + 1.1.3 (T)
1.3440	27.20	8.68	$\text{MgSO}_4 \cdot \text{H}_2\text{O}$	1.6553	66.49	0.38	1.3
1.3592	28.95	11.92	" + 1.1.3	1.7780	82.31	0.21	"
1.3641	29.81	12.37	1.1.3	1.8455	98.56	0.14	"

1.1.3 = $\text{MgSO}_4 \cdot \text{H}_2\text{SO}_4 \cdot 3\text{H}_2\text{O}$; 1.3 = $\text{MgSO}_4 \cdot 3\text{H}_2\text{SO}_4$.

Results for this system at 0° , 19° and 35.5° are given by Arditti, 1933, in the form of a diagram but without the numerical values. The author reported the solid phases to be $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$, $\text{MgSO}_4 \cdot \text{H}_2\text{SO}_4 \cdot 3\text{H}_2\text{O}$, $\text{MgSO}_4 \cdot \text{H}_2\text{SO}_4$, $3\text{MgSO}_4 \cdot 2\text{H}_2\text{SO}_4$ and $3\text{MgSO}_4 \cdot \text{H}_2\text{SO}_4$.

SOLUBILITY OF MAGNESIUM SULFATE IN AQUEOUS SOLUTIONS OF MAGNESIUM CHLORIDE. (Froehlich, 1929.)

The authors results were plotted and the following values taken from the average curves

Results for Aqueous Solutions Containing:

t° in each case	50 gms. MgCl_2 per liter		100 gms. MgCl_2 per liter		200 gms. MgCl_2 per liter	
	Gms. per 100 gms. sat. sol.		Gms. per 100 gms. sat. sol.		Gms. per 100 gms. sat. sol.	
	MgSO_4	MgCl_2	MgSO_4	MgCl_2	MgSO_4	MgCl_2
20	21.0	3.8	14.0	8.5	5.0	24.0
40	25.5	3.7	21.0	8.0	10.0	22.2
60	30.5	3.6	26.5	7.7	13.0	21.3
80	34.0	3.5	30.5	7.4	14.5	21.2
100	36.0	3.4	30.5	7.1	7.5	23.0
120	30.0	3.4	23.0	7.1	3.8	24.0

MAGNESIUM SULFATE

EQUILIBRIUM IN THE SYSTEM MAGNESIUM SULFATE, MANGANESE SULFATE AND WATER.

(Benrath and Blankenstein, 1934.)

Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase
MnSO ₄	MgSO ₄		MnSO ₄	MgSO ₄	
Results at 0°			Results at 50°		
3.56	18.19	MgSO ₄ ·7H ₂ O	2.24	32.0	MgSO ₄ ·6H ₂ O
6.17	17.68	"	3.15	31.3	"
10.66	14.61	"	8.43	27.6	"
14.21	12.77	"	12.40	25.5	"
17.83	11.0	"	13.04	24.8	M. C. Mn1 + MgO
23.1	8.37	M. C. Mg7 + Mn7	13.33	24.4	MnSO ₄ ·H ₂ O
25.11	6.91	MnSO ₄ ·7H ₂ O	16.00	21.2	"
29.25	3.97	"	19.30	17.08	"
32.0	1.88	"	26.00	10.46	"
			30.70	6.00	"
			33.8	2.36	"
Results at 23°			Results at 90°		
1.10	25.4	MgSO ₄ ·7H ₂ O			
1.83	25.3	"			
8.65	21.16	"	0.30	34.8	M. C. Mg1 + Mn1
14.27	17.86	"	1.64	33.6	" "
20.4	14.50	"	3.41	31.3	" "
26.3	11.88	"	5.72	29.5	" "
28.1	10.36	"	7.55	27.2	" "
28.5	9.36	M. C. Mg7 + Mn5	10.55	23.5	" "
		M. C. Mg6 + Mn5	13.68	20.4	" "
30.0	8.43	MnSO ₄ ·5H ₂ O	17.86	13.45	" "
33.7	5.00	"	20.1	9.43	" "
35.2	3.06	"	25.9	2.39	" "
37.7	1.04	"			

Mg7 = MgSO₄·7H₂O; Mg6 = MgSO₄·6H₂O; Mg1 = MgSO₄·H₂O.
Mn7 = MnSO₄·7H₂O; Mn5 = MnSO₄·5H₂O; Mn1 = MnSO₄·H₂O.

Mg7 = MgSO₄·7H₂O; Mg6 = MgSO₄·6H₂O; Mg1 = MgSO₄·H₂O.
 Mn7 = MnSO₄·7H₂O; Mn5 = MnSO₄·5H₂O; Mn1 = MnSO₄·H₂O.

The authors also give results for the temperatures 17.5°, 27°, 37°, 45°, and 70° as well as the composition of the solid phases and the values calculated to the Janecke x-m method of expressing the equilibrium.

EQUILIBRIUM IN THE SYSTEM AMMONIUM SULFATE + MAGNESIUM SULFATE + WATER.
(Weston, 1922.)

t.	Gms. per 100 gms. sat. sol.		Solid Phase	t.	Gms. per 100 gms. sat. sol.		Solid Phase
	MgSO ₄	(NH ₄) ₂ SO ₄			MgSO ₄	(NH ₄) ₂ SO ₄	
30.	0.00	43.60	(NH ₄) ₂ SO ₄	60.	0.0	46.8	(NH ₄) ₂ SO ₄
30.	0.30	41.20	(NH ₄) ₂ SO ₄ , MgSO ₄ ·6H ₂ O	60.	4.68	26.77	(NH ₄) ₂ SO ₄ , MgSO ₄ ·6H ₂ O
30.	1.25	26.15	"	60.	11.92	14.27	"
30.	7.30	10.55	"	60.	15.04	11.91	"
30.	16.53	6.31	"	60.	26.85	5.85	"
30.	27.60	2.98	"	60.	31.10	3.98	"

EQUILIBRIUM IN THE SYSTEM MAGNESIUM SULFATE, AMMONIUM
SULFATE AND WATER AT SEVERAL TEMPERATURES.
(Benrath and Thiemann, 1932.)

t°	Gms. per 100 MgSO ₄	gms. sat. sol. (NH ₄) ₂ SO ₄	Solid Phase	t°	Gms. per 100 MgSO ₄	gms. sat. sol. (NH ₄) ₂ SO ₄	Solid Phase
0	42.77	2.31	Mg7 + 1.1.6	62.4	34.64	3.27	1.1.6 + Mg6
25	26.44	2.29	" + "	65	0.73	46.04	" + (NH ₄) ₂ SO ₄
"	22.55	3.02	1.1.6	67.5	36.7	3.38	" + Mg6 + Mg1
"	12.0	5.96	"	75.0	1.74	46.43	" + (NH ₄) ₂ SO ₃
"	8.43	7.83	"	96	34.14	5.17	" + Mg1
"	3.02	15.0	"	"	29.33	10.87	" + "
"	1.3	23.32	"	"	27.14	12.28	1.1.6
"	0.56	31.94	"	"	24.26	14.21	"
"	0.0	43.22	"	"	17.35	19.08	"
45	31.22	3.0	" + Mg7	"	17.19	21.36	"
45.6	31.45	2.96	" + Mg7 + Mg6	"	14.27	24.94	"
46.2	31.69	2.89	" + Mg6	"	8.12	36.35	"
50	32.13	3.0	"	"	4.75	46.73	" + (NH ₄) ₂ SO ₄

Mg7 = MgSO₄·7H₂O; Mg6 = MgSO₄·6H₂O; Mg1 = MgSO₄·H₂O;
1.1.6 = MgSO₄·(NH₄)₂SO₄·6H₂O.

SO MAGNESIUM Ammonium SULFATE Mg(NH₄)₂(SO₄)₂.

SOLUBILITY OF AMMONIUM MAGNESIUM SULFATE IN WATER.
(Porlezza, 1914.)

t°.	Gms. per 100 Sat. Sol.	Gms. Water.	Solid Phase.	t°.	Gms. per 100 Sat. Sol.	Gms. Water.	Solid Phase.
-0.34	1.01	1.02	Ice	20	15.23	17.06	(NH ₄) ₂ Mg(SO ₄) ₂
-0.80	2.98	3.07	"	25	16.45	19.69	"
-1.23	4.92	5.17	"	30	17.84	21.71	"
-1.60	6.56	7.02	"	40	20.51	25.86	"
-2.02	8.34	9.10	"	50	23.18	30.17	"
-2.34 Eutec. ...	...	...	Ice + (NH ₄) ₂ Mg(SO ₄) ₂	60	26.02	35.17	"
0	10.58	11.83	(NH ₄)MgSO ₄	80	32.58	48.32	"
10	12.75	14.61	"	100	39.66	65.72	"

EQUILIBRIUM IN THE SYSTEM MAGNESIUM SULFATE, SODIUM NITRATE AND WATER.
(Schroder, 1930a.)

The authors present the complete data as determined by himself and others for the reciprocal salt pair MgSO₄ + Na₂(NO₃)₂ + H₂O, in the form of diagrams showing the fields of existence of the various components of the system at temperatures between 0° and 100°.

SOLUBILITY OF MAGNESIUM SULFATE IN AQUEOUS SOLUTIONS OF SODIUM SULFATE
AT 25° AND VICE VERSA. (Takegami, 1921.)

Gms. per 100 MgSO ₄	gms. sat. sol. Na ₂ SO ₄	Solid Phase.	Gms. per 100 MgSO ₄	gms. sat. sol. Na ₂ SO ₄	Solid Phase.
26.68	0.00	MgSO ₄ ·7H ₂ O	16.14	18.16	1.1.4
23.77	6.69	"	14.14	20.50	"
20.06	10.80	"	15.63	18.63	" + Na ₂ SO ₄ ·10H ₂ O
19.84	26.54	"	17.67	18.16	Na ₂ SO ₄ ·10H ₂ O
21.60	12.45	" + 1.1.4	10.93	19.17	"
19.46	14.13	1.1.4	10.78	18.85	"
18.28	15.89	"	3.34	20.88	"
16.31	18.22	"	0.00	21.54	"

1.1.4 = Astrakanite, MgSO₄·Na₂SO₄·4H₂O.

SOLUBILITY OF MAGNESIUM SULFATE OCTAHYDRATE IN AQUEOUS SOLUTIONS
OF SODIUM SULFATE AT 25° AND AT 30°. (Takegami, 1921 *a*, 1922.)

Results at 25°.

Gms. per 100 gms. sat. sol.		Solid Phase.
MgSO ₄ .	Na ₂ SO ₄ .	
26.68	0.00	MgSO ₄ ·8H ₂ O
25.48	2.73	"
25.04	3.54	"
24.49	5.20	"
23.49	7.50	"
22.32	10.10	"
21.27	12.76	"

Results at 30°.

Gms. per 100 gms. sat. sol.		Solid Phase.
MgSO ₄ .	Na ₂ SO ₄ .	
29.00	0.00	MgSO ₄ ·8H ₂ O
26.35	3.96	"
24.35	8.43	"
22.89	11.80	"
23.00	12.49	" + MgSO ₄ ·7H ₂ O
22.33	13.71	MgSO ₄ ·7H ₂ O
21.92	14.47	"

The tr. temp. of the 8 H₂O to 7 H₂O is at 45°·5-46°·1 in sodium sulfate solutions of 7 to 9 per cent concentration.

SOLUBILITY OF MAGNESIUM SULFATE IN AQUEOUS SOLUTIONS OF SODIUM
SULFATE AND VICE VERSA AT SEVERAL TEMPERATURES.

(Benrath, 1926.)

d. of sat. sol.	Gms. per 100 sat. sol.	Solid Phase	d. of sat. sol.	Gms. per 100 sat. sol.	Solid Phase
	MgSO ₄			Na ₂ SO ₄	
Results at 15°			Results at 50°		
1.294	25.13	0.0 Mg7	1.401	33.50	0.0 Mg6
—	24.92	0.26 "	1.410	32.50	1.96 "
1.291	24.75	0.75 "	1.426	31.60	3.95 "
1.292	24.33	1.68 "	1.428	31.32	4.74 "+1.1.4
1.286	23.81	3.97 "	1.414	27.49	7.55 1.1.4
1.301	22.29	7.88 "	1.380	20.16	13.86 "
—	21.59	10.93 "	1.374	15.75	18.62 "
1.319	20.88	11.72 "+Na10	1.381	11.98	23.25 "+Na ₂ SO ₄
1.271	13.89	9.92 Na10	1.364	9.80	24.77 Na ₂ SO ₄
—	8.09	9.90 "	1.329	3.52	29.42 "
1.185	3.63	10.07 "	1.310	0.0	31.70 "
1.132	1.21	10.92 "	Results at 97°		
1.105	0.0	11.72 "	1.400	35.60	0.0 Mg1
Results at 25°			1.401	33.89	2.01 "
1.304	26.68	0.0 Mg7	1.422	32.20	5.55 "+1.1
1.320	25.66	2.42 "	1.367	27.95	7.28 1.1
1.364	23.53	7.96 "	1.308	18.28	14.83 "
1.389	21.53	12.47 "+1.1.4	1.328	14.40	19.15 "+1.3
1.383	18.33	15.70 1.1.4	1.308	12.42	21.01 1.3
1.384	15.90	18.47 "+Na10	1.298	8.74	24.20 "
1.320	10.89	18.87 Na10	1.284	5.88	26.90 "+Na ₂ SO ₄
1.276	6.00	20.42 "	1.280	4.91	27.49 Na ₂ SO ₄
1.251	3.73	20.79 "	—	2.47	28.50 "
1.210	0.0	21.75 "	1.237	0.0	29.85 "

Mg7 = MgSO₄·7H₂O; Mg6 = MgSO₄·6H₂O; Mg1 = MgSO₄·H₂O; Na10 = Na₂SO₄·10H₂O; 1.1.4 = Astrakanite, MgSO₄·Na₂SO₄·4H₂O; 1.1 = MgSO₄·Na₂SO₄; 1.3 = Vanthoffite, MgSO₄·3Na₂SO₄. The author also gives results for the reciprocal salt pair MgSO₄ + Na₂(NO₃)₂ + H₂O at the above temperatures.

EQUILIBRIUM IN THE SYSTEM MAGNESIUM SULFATE, SODIUM SULFATE AND WATER
AT VARIOUS TEMPERATURES. (Archibald and Gale, 1924.)

t°.	Gms. per 100 gms. sat. sol.		Solid Phase.	t°.	Gms. per 100 gms. sat. sol.		Solid Phase.
	MgSO ₄ *	Na ₂ SO ₄			MgSO ₄	Na ₂ SO ₄	
0..	(20.63)	0.0	MgSO ₄ ·7H ₂ O	50..	32.8	2.51	MgSO ₄ ·6H ₂ O
0..	20.0	0.0	MgSO ₄ ·12H ₂ O	50..	31.3	5.7	" + I I 4
0..	20.0	4.3	" (?)	50..	30.45	6.15	1.1.4
0..	20.0	4.63	MgSO ₄ ·7H ₂ O + Na ₂ SO ₄ ·10H ₂ O	50..	27.8	9.75	"
0..	(19.66)	(3.92)	"	50..	18.2	16.0	"
0..	11.25	4.69	Na ₂ SO ₄ ·10H ₂ O	50..	16.0	18.3	"
0..	9.65	4.89	"	50..	14.1	21.8	"
10..	20.9	7.46	MgSO ₄ ·7H ₂ O + Na ₂ SO ₄ ·10H ₂ O	50..	13.7	23.8	" + MgSO ₄ ·3Na ₂ SO ₄
10..	19.4	7.4	Na ₂ SO ₄ ·10H ₂ O	50..	12.7	25.0	" + Na ₂ SO ₄
10..	0.75	8.3	"	50..	9.65	26.85	Na ₂ SO ₄
18.7.	25.7	0.5	MgSO ₄ ·7H ₂ O	50..	2.6	30.0	"
18.7.	24.4	3.4	"	60..	14.5	1.92	MgSO ₄ ·6H ₂ O
18.7.	20.60	11.48	"	60..	33.8	3.55	"
18.7.	20.57	11.80	" + Na ₂ SO ₄ ·10H ₂ O	60..	33.8	4.6	" + 1.1.4
18.7.	15.70	12.30	Na ₂ SO ₄ ·10H ₂ O	60..	30.0	6.5	1.1.4
18.7.	11.30	13.50	"	60..	23.1	12.0	"
18.7.	8.92	13.90	"	60..	18.2	15.8	"
18.7.	1.48	14.68	"	60..	14.0	21.8	"
25..	(28.04)	0.00	MgSO ₄ ·7H ₂ O	60..	9.9	24.85	Na ₂ SO ₄
25..	22.6	10.8	"	60..	6.05	27.85	"
25..	19.8	16.9	" + Na ₂ SO ₄ ·10H ₂ O*	80..	38.4	2.8	MgSO ₄ ·H ₂ O
25..	21.15	13.0	" + 1.1.4	80..	36.3	4.9	MgSO ₄ ·Na ₂ SO ₄ · $\frac{1}{2}$ H ₂ O
25..	(19.86)	(14.54)	"	80..	33.5	6.35	"
25..	16.6	17.8	Na ₂ SO ₄ ·10H ₂ O + 1.1.4	80..	24.06	12.6	"
25..	(15.88)	(18.52)	"	80..	18.1	17.85	"
25..	0.25	21.2	Na ₂ SO ₄ ·10H ₂ O	80..	16.4	19.7	"
25..	0.0	(21.87)	"	80..	15.4	21.4	"
30..	24.55	8.75	MgSO ₄ ·7H ₂ O	80..	14.7	22.0	"
30..	24.5	9.27	"	80..	14.55	22.3	" + MgSO ₄ ·3Na ₂ SO ₄
30..	23.25	12.35	" + 1.1.4	80..	14.2	22.55	MgSO ₄ ·3Na ₂ SO ₄
30..	15.8	18.6	1.1.4	80..	13.8	22.55	"
30..	12.3	23.25	" + Na ₂ SO ₄ ·10H ₂ O	80..	12.9	28.1	" (?) + Na ₂ SO ₄
30..	6.48	26.08	Na ₂ SO ₄ ·10H ₂ O	80..	0.0	30.4	Na ₂ SO ₄
40..	28.0	8.5	MgSO ₄ ·7H ₂ O + 1.1.4	100..	42.5	0.0	MgSO ₄ ·6H ₂ O*
40..	25.1	9.6	1.1.4	100..	40.6	0.0	MgSO ₄ ·H ₂ O
40..	24.1	10.8	"	100..	32.0	6.07	MgSO ₄ ·Na ₂ SO ₄ · $\frac{1}{2}$ H ₂ O
40..	20.95	13.8	"	100..	31.1	6.5	"
40..	15.35	19.15	"	100..	23.2	12.55	"
40..	13.15	22.80	"	100..	16.9	19.4	" (?) + MgSO ₄ ·3Na ₂ SO ₄
40..	12.2	23.2	"	100..	13.75	20.6	MgSO ₄ ·3Na ₂ SO ₄
40..	11.6	24.5	" + Na ₂ SO ₄	100..	13.7	20.5	"
40..	11.0	24.7	Na ₂ SO ₄	100..	0.0	29.8	Na ₂ SO ₄
40..	3.61	30.7	"				
40..	2.54	30.70	"				

* Indicates unstable equilibrium.

1.1.4 = Astrakanite MgSO₄·Na₂SO₄· $\frac{1}{2}$ H₂O.

The results in parentheses are by Kournakow and Zemczujnyj, 1919, 1924.

Determinations of the solubilities of the single salts and miscellaneous determinations at other temperatures were taken by the authors from the literature. They will be found under their respective headings in the present compilation.

Freezing-point data for mixtures of magnesium sulfate and sulfuric acid are given by Kendall and Davison, 1921.

EQUILIBRIUM IN THE SYSTEM MAGNESIUM SULFATE, SODIUM SULFATE
AND WATER AT VARIOUS TEMPERATURES.

(Blasdale and Robson, 1928.)

t°	Gms. per 100 gms. H ₂ O		Solid Phase	t°	Gms. per 100 gms. H ₂ O		Solid Phase
	MgSO ₄	Na ₂ SO ₄			MgSO ₄	Na ₂ SO ₄	
0	25.6	5.1	Mg7 + Na10	130	2.3	41.7	Na ₂ SO ₄ + 1.3
25	32.1	19.7	Mg7+1.1.4	150	1.4	41.8	"
30 (R)	35.3	18.2	Mg7+1.1.4	175	0.7	41.7	"
25	25.4	27.1	Na10+1.1.4	70	50.4	7.6	1.1.2/5+MgSO ₄ ·H ₂ O
55 (D'A)	50.2	8.3	Mg6+1.1.4	75	49.2	7.7	"
30 (R)	19.1	36.1	Na ₂ SO ₄ +1.1.4	85	47.3	8.0	"
65 (D'A)	21.0	36.2	"	95	43.6	10.0	"
75	20.0	36.2	"	100	41.8	10.9	"
86.5	18.0	36.7	"	130	33.2	16.4	"
90 (D'A)	17.7	37.5	"	148	27.9	18.1	"
67	22.1	34.4	1.3 + "	180	15.2	18.5	"
67	16.0	37.5	Na ₂ SO ₄ +1.3	75	23.4	29.7	" + 1.3
70	15.0	37.8	"	85	23.0	28.5	"
75	12.8	38.4	"	95	21.7	28.0	"
76.5	12.0	38.6	"	100	21.0	27.9	"
85	9.3	39.2	"	130	19.0	27.7	"
86.5	8.8	39.4	"	150	17.3	25.4	"
95	6.7	40.0	"	180	15.7	23.2	"
100	5.8	40.2	"	210	8.5	19.5	MgSO ₄ ·H ₂ O+1.3

(R) = Roozeboom, 1887, 1888; (D'A) = D'Ans, 1915.

Mg7 = MgSO₄·7H₂O; Mg6 = MgSO₄·6H₂O; Na10 = Na₂SO₄·10H₂O; 1.1.4 = Astrakanite, MgSO₄·Na₂SO₄·4H₂O; 1.3 = Vantoffite, MgSO₄·3Na₂SO₄; 1.1.2/5 = Löweite, MgSO₄·Na₂SO₄·2/5 H₂O.

The authors give a diagram composed of the isotherms constructed from their own and other results. From this the composition of any stable solution in equilibrium with one or more solid phases can be found for any temperature between 0 and 210°.

A similar presentation of all available determinations upon this system, calculated to both the weight percent and gram molecular basis, is given by Froelisch, 1929.

SOLUBILITY OF MIXTURES OF SODIUM SULFATE AND MAGNESIUM SULFATE
IN WATER (ASTRAKANITE) Na₂Mg(SO₄)₂·4H₂O.

(Roozeboom, 1887, 1888.)

t°.	Mols. per 100 Mols. H ₂ O.		Grams per 100 Grams H ₂ O.		Solid Phase.
	Na ₂ SO ₄ .	MgSO ₄ .	Na ₂ SO ₄ .	MgSO ₄ .	
22	2.95	4.70	23.3	31.4	Astrakanite
24.5	3.45	3.68	27.2	24.6	"
30	3.59	3.59	28.4	24.1	"
35	3.71	3.71	29.4	24.8	"
47	3.6	3.6	28.4	24.1	"
22	2.95	4.70	23.3	31.4	Astrakanite + Na ₂ SO ₄
24.5	3.45	3.62	27.2	24.2	"
30	4.58	2.91	36.1	19.1	"
35	4.3	2.76	33.9	18.44	"
18.5	3.41	4.27	43.0	45.5	Astrakanite + MgSO ₄
22	2.85	4.63	35.2	48.9	"
24.5	2.68	4.76	32.5	50.3	"
30	2.3	5.31	25.0	55.0	"

Mg MAGNESIUM

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EQUILIBRIUM IN THE SYSTEM MAGNESIUM SULFATE, SODIUM SULFATE AND WATER AT 63°.

(Schroder, 1929.)

At this temperature the three double salts astrakanite, $\text{MgSO}_4 \cdot \text{Na}_2\text{SO}_4 \cdot 4\text{H}_2\text{O}$ (1.1.4) Löweite, $\text{MgSO}_4 \cdot \text{Na}_2\text{SO}_4 \cdot 2/5\text{H}_2\text{O}$ (1.1.2/5) and Vanthoffite, $\text{MgSO}_4 \cdot 3\text{Na}_2\text{SO}_4$ (1.3) exist, and there are certain regions of metastability. Great care is required to reach equilibrium and periods of constant shaking from 142 to 1,800 hours were employed.

d. of sat. sol.	Gms. per 100 gms. sat. sol.		Solid Phase	d. of sat. sol.	Gms. per 100 gms. sat. sol.		Solid Phase
	MgSO_4	Na_2SO_4			MgSO_4	Na_2SO_4	
1.4114	35.33	0.0	$\text{MgSO}_4 \cdot 6\text{H}_2\text{O}$	1.3729	20.48	13.90	1.1.4
1.4182	34.86	1.04	"	1.3728	19.94	14.46	"
1.4365	33.86	3.55	"	1.3706	19.08	15.37	"
1.4377	33.70	3.98	" + 1.1.2/5	1.3651	14.19	20.65	"
1.4212	30.92	5.48	1.1.2/5	1.3687	12.34	22.89	" + Na_2SO_4
1.4092	29.06	6.90	"	1.3697	13.82	21.40	1.3
1.4045	28.15	7.75	" + 1.1.4	1.3651	13.12	21.91	" + 1.1.4
1.3926	25.44	9.84	1.1.2/5	1.3634	12.35	22.64	1.3
1.3725	16.18	19.34	"	1.3642	11.70	23.33	" + Na_2SO_4
1.4120	29.49	6.80	1.1.4	1.3635	11.34	23.68	1.3
1.4035	27.89	7.80	"	1.3695	12.69	22.59	Na_2SO_4
1.3982	26.81	8.53	"	1.3419	8.35	25.43	"
1.3868	24.31	10.57	"	1.3215	4.96	27.59	"
1.3829	23.53	11.20	"	1.2908	0.0	30.70	"
1.3795	22.86	11.82	"				

EQUILIBRIUM IN THE SYSTEM MAGNESIUM SULFATE THALLIUM SULFATE AND WATER AT SEVERAL TEMPERATURES.

(Benrath, 1931.)

t°	Gms. per 100 gms. sat. sol.		Solid Phase	t°	Gms. per 100 gms. sat. sol.		Solid Phase
	Ti_2SO_4	MgSO_4			Ti_2SO_4	MgSO_4	
0	2.39	22.37	$\text{Mg7} + 1.1.6$	40.5	10.98	15.13	Ti_2SO_4
"	3.02	12.66	1.1.6	"	8.36	3.77	"
"	3.76	7.42	" + Ti_2SO_4	"	7.74	1.92	"
17.6	3.36	24.64	$\text{Mg7} + 1.1.6$	64.5	4.70	15.08	Mg6
"	4.88	17.52	1.1.6	"	6.47	14.53	" + 1.1.6
"	5.75	13.76	"	"	12.22	26.98	1.1.6
"	6.40	12.0	" + Ti_2SO_4	"	15.20	22.65	" + Ti_2SO_4
40.5	2.59	31.0	Mg7	"	15.91	18.40	Ti_2SO_4
"	5.06	30.05	" + 1.1.6	"	12.52	4.67	"
"	6.86	25.12	1.1.6	100	9.41	30.34	$\text{MgSO}_4 \cdot \text{H}_2\text{O}$
"	9.42	19.66	"	"	24.7	25.4	" + Ti_2SO_4
"	10.78	15.62	" + Ti_2SO_4	"	23.65	18.55	Ti_2SO_4

1.1.6 = $\text{MgSO}_4 \cdot \text{Ti}_2\text{SO}_4 \cdot 6\text{H}_2\text{O}$; $\text{Mg6} = \text{MgSO}_4 \cdot 6\text{H}_2\text{O}$; $\text{Mg7} = \text{MgSO}_4 \cdot 7\text{H}_2\text{O}$.

SOLUBILITY OF MAGNESIUM SULFATE IN METHYL AND ETHYL ALCOHOLS

(de Bruyn, 1892)

Solvent.	t°	Per 100 Gms. Solvent	Solvent.	t°	Per 100 Gms. Solvent.
Abs. CH_3OH	18	1.18 gms. MgSO_4	93% Methyl Alc.	17	0.7 gms. $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$
"	17	41 " $\text{MgSO}_4 \cdot (\text{H}_2\text{O})$	50% " "	3-4	4.1 " "
"	3-4	29 " "	Abs. $\text{C}_2\text{H}_5\text{OH}$	3	1.3 " "

MAGNESIUM SULFATE

SOLUBILITY OF MAGNESIUM SULFATE IN AQUEOUS SOLUTIONS OF
ETHYL ALCOHOL AT 25° AND AT 50°.

(Taraszenkow and Katz, 1937.)

Results at 25°

Results at 50°

Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.				Solid Phase
C_2H_5OH	$MgSO_4$		Upper Layer		Lower Layer		
			C_2H_5OH	$MgSO_4$	C_2H_5OH	$MgSO_4$	
0.0	26.70	$MgSO_4 \cdot 7H_2O$	No separation		0.0	33.44	$MgSO_4 \cdot 6H_2O$
13.20	15.09	"	"	"	2.69	32.12	"
28.70	4.84	"	"	"	3.10	31.10	"
39.72	1.07	"	60.38	0.32	4.10	30.74	"
63.54	0.04	"	50.75	1.02	6.10	26.78	"
71.61	0.02	"	41.76	1.94	7.64	23.85	"
			39.11	2.99	10.41	21.17	"
At 50° a separation into two liquid layers occurs be- tween 3 and 65 weight percent ethyl alcohol.			34.12	5.11	11.69	19.16	"
			32.26	5.61	13.95	16.74	"
			64.79	0.15	No separation		"

SOLUBILITY OF ANHYDROUS MAGNESIUM SULFATE IN
METHYL ALCOHOL AND IN ETHYL ALCOHOL.

(Olson, Driscoll and Jones, 1929.)

Results for Methyl Alcohol

Results for Ethyl Alcohol

t°	Gms. $MgSO_4$ per 100 gms. CH_3OH	Solid Phase	t°	Gms. $MgSO_4$ per 100 gms. C_2H_5OH	Solid Phase
15	0.276	$MgSO_4 \cdot 3\frac{1}{2}CH_3OH$	15	0.025	$MgSO_4$
25	0.224	"	35	0.020	"
35	0.180	"	55	0.016	"
45	0.153	"			
55	0.123	"			

SOLUBILITY OF MAGNESIUM SULFATE IN SEVERAL SOLVENTS.

t°	Solvent	Gms. $MgSO_4$ per 100 gms. sat. sol.	Authority
19	95% Formic acid	0.34	(Aschan, 1933.)
25	Pure Glycerol (d $\frac{25}{4}$ = 1.246)	20.8	(Schnellbach and Rosin, 1929.)
31.25	Aq. 46.5 Wt. Percent Cane Sugar Solution	14.0	(Köhler, 1897.)

SOLUBILITY OF MAGNESIUM SULFATE IN AQUEOUS SOLUTIONS OF
ISO PROPYL ALCOHOL AT 25°.
(Ginnings and Chen, 1931.)

The results locate the binodal curve of the system, including a tie line,* , which shows the composition of two liquid layers in contact with each other, and the plait point, PP, at which the two liquid layers became homogeneous.

Gms. per 100 gms. sat. sol.		Gms. per 100 gms. sat. sol.	
iso C_3H_7OH	$MgSO_4$	iso C_3H_7OH	$MgSO_4$
39.30	1.43	12.10	11.80
32.80	2.77	9.40	14.00
28.40	4.20	7.10	16.40
23.70	5.90	5.00	19.40
21.4	7.3 PP	3.00	22.50*

The composition of the homogeneous mixture, Plait point PP, of the system $MgSO_4$ + Tertiary Butyl Alcohol + H_2O at 25° was found by Ginnings, Herring and Webb, 1933 to be,

3.3 percent $MgSO_4$ + 27.2 percent ter. $(CH_3)_3COH$ + 69.5 percent H_2O . The original results for the remaining points on the binodal curve are not given but only the values of constants calculated from empirical equations.

The binodal curve of the system $MgSO_4$ + Allyl Alcohol + H_2O at 25° has been determined by Ginnings and Dees, 1935; and that for the system $MgSO_4$ + Pyridine + H_2O at 25° has been determined by Ginnings, Webb and Hinohara, 1933. The authors do not give their experimental results but only the values of a series of arbitrary constants calculated from them by means of empirical equations. The results showed that allyl alcohol is more difficult to salt out than iso propyl or normal propyl alcohol.

EQUILIBRIUM IN THE SYSTEM MAGNESIUM SULFATE, UREA AND WATER AT 30°.
(Whittaker, Lundstrom and Shimp, 1936.)

Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase
$MgSO_4$	$CO(NH_2)_2$		$MgSO_4$	$CO(NH_2)_2$	
28.42	0.0	$MgSO_4 \cdot 7H_2O$	21.14	46.04	1.1.3
28.16	4.13	"	20.79	50.35	"
28.00	11.15	"	20.96	51.09	" + $CO(NH_2)_2$
28.32	20.80	" + 1.1.3	21.08	54.49	$CO(NH_2)_2$
28.19	22.84	1.1.3	17.64	52.15	"
25.96	27.36	"	14.18	52.93	"
25.16	32.57	"	9.21	54.79	"
23.84	36.66	"	4.47	55.42	"
21.64	43.00	"	0.0	57.00	"

EQUILIBRIUM IN THE SYSTEM MAGNESIUM SULFATE, URETHAN AND WATER AT 25°.
(Palitzsch, 1929, 1929.)

Gm. Mols. per 1000 gms. H_2O		Solid Phase
$MgSO_4$	NH_2COONH_4	
3.029	0.0	$MgSO_4 \cdot 7H_2O$
0.0	35.69	Upper liquid layer
2.854	0.3704	Lower liquid layer
0.0	53.09	$NH_2COONH_4 \cdot H_2O$

Data for the system magnesium sulfate, phenol, and water are given by Timmermans, 1907.

Fusion-point data for mixtures of $\text{MgSO}_4 + \text{K}_2\text{SO}_4$ are given by Ginsberg, 1906; Nacken, 1907a and Grahnann, 1913. Results for $\text{MgSO}_4 + \text{Na}_2\text{SO}_4$ are given by Nacken 1907b.

MAGNESIUM Di THIONATE $\text{MgS}_2\text{O}_6 \cdot 6\text{H}_2\text{O}$.

SOLUBILITY OF MAGNESIUM DITHIONATE IN WATER. (de Baat, 1926.)

t°	0°	1°	20°	30°
Gms. MgS_2O_6 per 100 gms. sat. sol.....	31.94	33.30	33.91	35.21

MAGNESIUM SELENATE $\text{MgSeO}_4 \cdot 6\text{H}_2\text{O}$.

SOLUBILITY OF MAGNESIUM SELENATE IN WATER.
(Meyer and Aulich, 1928.)

t°	Gms. MgSeO_4 per 100 gms. sat. sol.	Solid Phase	t°	Gms. MgSeO_4 per 100 gms. sat. sol.	Solid Phase	Sol.
7.5	9.2	Ice + $\text{MgSeO}_4 \cdot 7\text{H}_2\text{O}$	25	27.5	$\text{MgSeO}_4 \cdot 6\text{H}_2\text{O}$	
0	16.7		30	31.2	"	
4.7	31.2*	$\text{MgSeO}_4 \cdot 6\text{H}_2\text{O}$	40	32.3	"	
7.5	32.1*	"	40	33.8*	"	
8.0	23.0	" + $\text{MgSeO}_4 \cdot 7\text{H}_2\text{O}$	50	34.9	"	
20.	27.2	$\text{MgSeO}_4 \cdot 6\text{H}_2\text{O}$	60	35.8	"	

* Metastable

The mixtures were shaken for periods of 4 to 6 hours.

EQUILIBRIUM IN THE SYSTEM MAGNESIUM SELENATE, AMMONIUM SELENATE AND WATER AT 30° .

(Lawrence and King, 1938.)

Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase
$(\text{NH}_4)_2\text{SeO}_4$	MgSeO_4		$(\text{NH}_4)_2\text{SeO}_4$	MgSeO_4	
0.0	36.60	$\text{MgSeO}_4 \cdot 6\text{H}_2\text{O}$	20.24	5.63	1.1.6
1.25	36.66		26.20	3.24	"
2.26	36.76	" + 1.1.6	33.60	1.55	"
2.53	36.08	1.1.6	36.40	1.17	"
5.03	27.60	"	40.50	0.70	"
9.73	17.48	"	52.26	0.22	"
16.60	8.95	"	55.15	0.21	" + $(\text{NH}_4)_2\text{SeO}_4$
			54.16	0.0	$(\text{NH}_4)_2\text{SeO}_4$

1.1.6 = $\text{MgSeO}_4 \cdot (\text{NH}_4)_2\text{SeO}_4 \cdot 6\text{H}_2\text{O}$.

The mixtures were shaken for at least 12 hours. The authors give no explanation of the difference between their result in water alone and that of Meyer and Aulich, at 30° .

Mn MANGANESE

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EQUILIBRIUM IN THE SYSTEM MAGNESIUM SELENATE, SODIUM SELENATE AND WATER AT 25°.

(Meyer and Aulich, 1928.)

Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase
Na_2SeO_4	MgSeO_4		Na_2SeO_4	MgSeO_4	
0.0	27.5	$\text{MgSeO}_4 \cdot 6\text{H}_2\text{O}$	24.32	14.36	$\text{MgSeO}_4 \cdot 6\text{H}_2\text{O}$
12.32	20.20	"	28.76	15.18(?)	"
14.36	19.90	"	31.22	10.66	" + $\text{Na}_2\text{SeO}_4 \cdot 10\text{H}_2\text{O}$
17.20	18.30	"	33.24	8.22	$\text{Na}_2\text{SeO}_4 \cdot 10\text{H}_2\text{O}$
20.11	16.98	"	36.4	0.0	"

The mixtures were shaken for periods of 24-36 hours.

MAGNESIUM SILICATE MgSiO_3 .

Fusion-point data for mixtures of $\text{MgSiO}_3 + \text{MnSiO}_3$ are given by Lebedew (1911). Results for $\text{MgSiO}_3 + \text{Na}_2\text{SiO}_3$ are given by Wallace (1909).

MANGANESE Mn

SOLUBILITY OF MANGANESE IN MERCURY AT 20°.

(Irvin and Russell, 1929.)

An amalgam of 1 gm. Mn in 200 gms. Hg was passed through a sintered glass filter and the manganese in the weighed filtrate found to correspond to a solubility of 0.001 percent with an error of 10%. A determination by Tammann, Kollmann and Hindner, 1927, by the electro-metric method, gave 0.00025 gm. Mn per 100 gm. Hg.

BO MANGANESE BORATE $\text{MnH}_2(\text{BO}_3)_2$.

SOLUBILITY IN WATER AND IN AQUEOUS SALT SOLUTIONS.

(Hartley and Ramage - J. Ch. Soc. 63, 137, '91.)

t°.	Grams $\text{MnH}_2(\text{BO}_3)_2$ per Liter in Solutions of.				
	$\text{H}_2\text{O} +$ trace Na_2SO_4 .	Na_2SO_4 (0.2 Gms. per Liter).	Na_2SO_4 (20 Gms. per Liter).	NaCl (20 Gms. per Liter).	CaCl_2 (20 Gms. per Liter).
14	0.94	1.7	...	...	...
18	...	...	0.77	1.31	2.01
40	0.50	0.69 (52°)	0.65	...	2.44
60	...	...	0.36	0.60	2.25
80	0.08	...	0.12	0.29	1.35

MANGANESE BROMIDE MnBr_2 .

SOLUBILITY IN WATER.

(Etard, 1894.)

Br	t°.	Gms. MnBr_2 per 100 Gms. Solution.	Solid Phase.	t°.	Gms. MnBr_2 per 100 Gms. Solution.	Solid Phase.
	-20	52.3	$\text{MnBr}_2 \cdot 4\text{H}_2\text{O}$	40	62.8	$\text{MnBr}_2 \cdot 4\text{H}_2\text{O}$
	-10	54.2	"	50	64.5	"
	0	56.0	"	60	66.3	"
	10	57.6	"	70	68.0	"
	20	59.5	"	80	69.2	$\text{MnBr}_2 \cdot \text{H}_2\text{O}$
	25	60.2	"	90	69.3	"
	30	61.1	"	100	69.5	"

MANGANESE ACETATE $\text{Mn}(\text{CH}_3\text{COO})_2 \cdot 4\text{H}_2\text{O}$.

100 gms. H_2O dissolve 64.5 gms. $\text{Mn}(\text{CH}_3\text{COO})_2 \cdot 4\text{H}_2\text{O}$ at 5° . The determination was made by adding water gradually to a weighed amount of the pure compound until the last few remaining fragments of crystals just disappeared.

(Cadenhead and Vining, 1924.)

100 gms. Methyl Alcohol, sat. with anhydrous Mn Acetate, dissolve 4.76 gms. $\text{Mn}(\text{CH}_3\text{COO})_2$ at 15° and 12.30 gm. at 66.2° (b.pt.). (Henstock, 1934.)

MANGANESE GLUCONATE $\text{Mn}(\text{C}_6\text{H}_{11}\text{O}_7)_2$.

100 gms. sat. solution of manganese gluconate in water contain 16.8 gms. $\text{Mn}(\text{C}_6\text{H}_{11}\text{O}_7)_2$ at 25° . (May, Weisberg and Herrick, 1929.)

MANGANESE BENZOATE $\text{Mn}(\text{C}_6\text{H}_5\text{COO})_2 \cdot 2\text{H}_2\text{O}$.**MANGANESE Chlor, Oxy, etc. BENZOATES.**

CH

SOLUBILITY OF EACH SEPARATELY IN WATER AT 20° .

(Ephraim and Pfister, 1925.)

Compound.	Formula.	Gms. anhydrous empd. per 100 cc. sat. sol.
Manganese Benzoate.....	$\text{Mn}(\text{C}_6\text{H}_5\text{COO})_2 \cdot 2\text{H}_2\text{O}$	4.82
» -4 Chlor Benzoate..	$\text{Mn}(\text{C}_6\text{H}_4\text{.Cl.COO})_2 \cdot 2\text{H}_2\text{O}$	1.157
» -4 Oxy » ..	$\text{Mn}(\text{C}_6\text{H}_4\text{.OH.COO})_2 \cdot 8\text{H}_2\text{O}$	3.324
» -4 Methoxy » ..	$\text{Mn}(\text{C}_6\text{H}_4\text{.OCH}_3\text{.COO})_2 \cdot 3\text{H}_2\text{O}$	1.452
» -4 Nitro » ..	$\text{Mn}(\text{C}_6\text{H}_4\text{.NO}_2\text{.COO})_2 \cdot 6\text{H}_2\text{O}$	1.341

MANGANESE CINNAMATE $\text{MnC}_{18}\text{H}_{14}\text{O}_4 \cdot 2\text{H}_2\text{O}$.

100 cc. sat. sol. of manganese cinnamate in water contain 0.214 gm. $\text{MnC}_{18}\text{H}_{14}\text{O}_4$ at 20° .

(Ephraim and Pfister, 1925.)

100 gms. H_2O dissolve 0.26 gm. $\text{MnC}_{18}\text{H}_{14}\text{O}_4$ at 26° . (DeJong, 1909.)

MANGANESE FUMARATE $\text{MnC}_4\text{H}_2\text{O}_4$.

100 gms. H_2O dissolve 0.14 gm. $\text{MnC}_4\text{H}_2\text{O}_4$ at 30° . (Weiss and Downs, 1923.)

MANGANESE HELIANTHATE $(\text{C}_{11}\text{H}_{11}\text{N}_3\text{SO}_3)_2 \cdot 4\text{H}_2\text{O}$.

1000 cc. H_2O dissolve 0.06 gm. of the salt at $20-25^\circ$. (Stark and Dehn, 1918.)

Mn MANGANESE

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MANGANESE Anthracene, Benzene and Naphthalene SULFONATES.

SOLUBILITY OF EACH SEPARATELY IN WATER.
(Ephraim and Pfister, 1925, 1925a; Ephraim and Seger, 1925.)

Compound.	Formula.	t°	Gms. anhydrous compd. per 100 cc. sat. sol.
Manganese Anthracene-1-sulfonate.....	Mn C ₁₄ H ₉ SO ₃ ·2.6H ₂ O	20	0.0477
" " -2- "	Mn C ₁₄ H ₉ SO ₃ ·6H ₂ O	20	0.00575
" Benzene sulfonate.....	Mn C ₆ H ₅ SO ₃ ·6H ₂ O	18	13.998
" " "	"	20	16.348
" " "	"	34	18.840
" " "	"	49.5	24.696
" " "	"	64.5	32.215
" " "	"	80.5	42.924
" Naphthalene 1-sulfonate.....	Mn C ₁₀ H ₇ SO ₃ ·6H ₂ O	17.0	0.479
" " -2- "	Mn C ₁₀ H ₇ SO ₃ ·6H ₂ O	16.5	0.334
" " "	"	20	0.384
" " "	"	32	0.532
" " "	"	45	0.816
" " "	"	59	1.359
" " "	"	70.5	1.946
" " "	"	74	2.186
" " "	"	77	2.382
" " "	"	81.5	2.859
" " 5 chlor-1 sulfonate.	Mn C ₁₄ H ₈ SO ₃ Cl·H ₂ O	20	0.742
" " 6 oxy-2- "	Mn C ₁₂ H ₈ SO ₃ ·3H ₂ O	20	1.200

CO

MANGANESE CARBONATE MnCO₃.

One liter water dissolves 5.659.10⁻⁴ mola. MnCO₃ = 0.065 gm. at 25°.
(Agemo and Valla, 1911.)

100 gms. of a sat. solution of Mn CO₃ in water at 18° and in contact with CO₂ at a pressure of 1 atmosphere contain 0.04 gm. Mn CO₃. At a pressure of 56 atmospheres 0.080 gm. is dissolved.
(Haehncl, 1924.)

MANGANESE Campho CARBONATE Mg(C₁₀H₁₅O.COO)₂.

1000 cc. sat. solution of Manganese Campho Carbonate in Methyl Alcohol contain 10.5 gms. Mg(C₁₀H₁₅O.COO)₂ at 19.5°.

1000 cc. sat. solution of Manganese Campho Carbonate in Ethyl Alcohol contain 0.36 gm. Mg(C₁₀H₁₅O.COO)₂ at 9°. (Picon, 1931.)

MANGANESE OXALATE MnC₂O₄·2H₂O and 3H₂O.

SOLUBILITY OF EACH OF THE HYDRATES SEPARATELY IN WATER.

(Chamberlain, Hume and Topley, 1926.)

COO

Saturation was secured by constant stirring in a thermostat. The trihydrate changes gradually to the dihydrate. The error due to this change was very slight. The results in parentheses are by Chatterjee and Dhar, 1924.

Results for the Dihydrate.			Results for the Trihydrate.		
t°.	Gms. MnC ₂ O ₄ per 100 gms. sat. sol.	Solid Phase	t°	Gms. MnC ₂ O ₄ per 100 gms. sat. sol.	Solid Phase.
0.0..	0.0198	MnC ₂ O ₄ ·2H ₂ O	0.0..	0.0306	MnC ₂ O ₄ ·3H ₂ O
6.3..	0.0225	"	6.3..	0.0388	"
12.8..	0.0256	"	12.8..	0.0476	"
20.1..	0.0285	"	20.1..	0.0582	"
25.0..	0.0308	"	25.0..	0.0669	"
30.3..	0.0335	"	30.0..	0.0769	"
36.0..	0.0369 (0.0375)	"	39.0..	(0.0780)	MnC ₂ O ₄ ·2H ₂ O

More recent determinations gave the following results.

t°	Gms. MnC_2O_4 per liter sat. solution	Solid Phase	Authority
18	0.2697	$\text{MnC}_2\text{O}_4 \cdot 2\text{H}_2\text{O}$	(Scholder, 1930.)
25	0.3087	"	(Money and Davies, 1934.)
18	0.5368	$\text{MnC}_2\text{O}_4 \cdot 3\text{H}_2\text{O}$	(Scholder, 1930.)

MANGANESE OXALATE $\text{MnC}_2\text{O}_4 \cdot 2\text{H}_2\text{O}$.

SOLUBILITY IN AQUEOUS SOLUTIONS AT 25°.

(Hauser and Wirth, 1909.)

In Oxalic Acid Solutions.		In Ammonium Oxalate Solutions.		In Sulfuric Acid Solutions.		Solid Phase.
Per 1000 Gms. Sat. Sol.	Gms.	Per 1000 Gms. Sat. Sol.	Gms.	Per 1000 Gms. Sat. Sol.	Gms.	
G. Mols. (COOH) ₂ .	$\text{Mn}(\text{COO})_2$.	G. Mols. $(\text{NH}_4)_2(\text{COO})_2$.	$\text{Mn}(\text{COO})_2$.	Normality H_2SO_4 .	$\text{Mn}(\text{COO})_2$.	
0	0.312	0.005	0.338	0.025	1.825	$\text{MnC}_2\text{O}_4 \cdot 2\text{H}_2\text{O}$
0.0125	0.759	0.025	0.479	0.24	8.850	"
0.025	0.930	0.050	0.761	1	25.955	"
0.050	1.080	0.125	1.789	2.389	51.080	"
0.125	1.396	0.245	3.970	2.987	60.100	$\text{MnC}_2\text{O}_4 \cdot 2\text{H}_2\text{O} + (\text{COOH})_2$
0.25	1.708	0.245	4.005	3.952	73.200	"
0.49	2.081	0.281	4.650	4.500	82.401	"

Results are also given for the solubility of $\text{MnC}_2\text{O}_4 \cdot 2\text{H}_2\text{O}$ in aq. solutions of H_2SO_4 containing also about 0.25 gm. mols. free oxalic acid per liter at 25°

SOLUBILITY OF MANGANESE OXALATE IN AQUEOUS SALT SOLUTIONS AT 25°.

(Money and Davies, 1934.)

Results for Aqueous Solutions of:

Manganese Chloride		Potassium Oxalate		Sodium Oxalate	
Gm. Mols. per liter sat. sol.		Gm. Mols. per liter sat. sol.		Gm. Mols. per liter sat. sol.	
MnCl_2	MnC_2O_4	$\text{K}_2\text{C}_2\text{O}_4$	MnC_2O_4	$\text{Na}_2\text{C}_2\text{O}_4$	MnC_2O_4
0.0	0.00216	0.0405	0.002869	0.07806	0.004624
0.005	0.001672	0.1198	0.006065	0.1600	0.007708
0.05	0.0016	0.1994	0.009529	0.2411	0.01097

MANGANESE CHLORIDE MnCl_2 .

SOLUBILITY IN WATER.

(Etard; Dawson and Williams — Z. physik. Chem. 31, 63, '99.)

t°.	Sp. Gr. of Solutions.	Grams MnCl_2 per 100 Grams		Mols. MnCl_2 per 100 Mols. H_2O .	Solid Phase.
		Water.	Solution.		
-20	...	53.8	35.0	...	$\text{MnCl}_2 \cdot 4\text{H}_2\text{O}$
-10	...	58.7	37.0	...	"
0	...	63.4	38.8	...	"
+10	...	68.1	40.5	...	"
20	...	73.9	42.5	...	"
25	1.4991	77.18	43.55	11.08	"
30	1.5049	80.71	44.68	11.55	"
40	1.5348	88.59	46.96	12.69	"
50	1.5744	98.15	49.53	14.05	"
57.65	1.6097	105.4	51.33	15.10	"
60	1.6108	108.6	52.06	15.55	$\text{MnCl}_2 \cdot 2\text{H}_2\text{O}$
70	1.6134	110.6	52.52	15.85	"
80	...	112.7	52.98	16.14	"
90	...	114.1	53.2	...	"
100	...	115.3	53.5	...	"
120	...	118.8	54.3	...	"
140	...	119.5	55.0	...	"

Cl

More recent results for the solubility of MnCl_2 in Water, in fairly close agreement with the above, are given by Benrath, 1934.

One liter of water dissolves 87.0 grams MnCl_2 . One liter of sat. HCl dissolves 19.0 grams MnCl_2 at 12°.

(Ditte — Compt. rend. 92, 242, '81.)

EQUILIBRIUM IN THE SYSTEM MANGANESE CHLORIDE, POTASSIUM CHLORIDE AND WATER. (Süss, 1913.)

t°.	Gms per 100 Gms. Sat. Sol.		Solid Phase.	t°.	Gms. per 100 Gms. Sat. Sol.		Solid Phase.
	MnCl_2 .	KCl.			MnCl_2 .	KCl.	
6	40.23	...	$\text{MnCl}_2 \cdot 4\text{H}_2\text{O}$	52.8	50.14	6.01	$\text{MnCl}_2 \cdot 4\text{H}_2\text{O} + \text{MnCl}_2 \cdot 2\text{H}_2\text{O} + 1.1.2$
6	35.94	9.41	" + 1.1.2 + KCl	58.3	51.72	...	$\text{MnCl}_2 \cdot 4\text{H}_2\text{O} + \text{MnCl}_2 \cdot 2\text{H}_2\text{O}$
6	...	23.06	KCl	62.6	51.86	...	$\text{MnCl}_2 \cdot 2\text{H}_2\text{O}$
28.4	44.46	...	$\text{MnCl}_2 \cdot 4\text{H}_2\text{O}$	62.6	49.95	6.67	" + 1.1.2
28.4	43.28	8.66	" + 1.1.2	62.6	44.05	12.49	1.1.2 + $\text{MnCl}_2 \cdot 2\text{H}_2\text{O}$
28.4	38.65	13.79	" + 1.1.2 + KCl	62.6	36.85	18.77	$\text{MnCl}_2 \cdot 2\text{KCl} \cdot 2\text{H}_2\text{O} + \text{MnCl}_2 \cdot 4\text{KCl}$
28.4	...	20.91	KCl	62.6	...	31.57	KCl

1.1.2 = $\text{MnCl}_2 \cdot \text{KCl} \cdot 2\text{H}_2\text{O}$. 1.2.2 = $\text{MnCl}_2 \cdot 2\text{KCl} \cdot 2\text{H}_2\text{O}$

SOLUBILITY OF MIXTURES OF AMMONIUM AND MANGANESE CHLORIDES IN WATER AT 25°.

(Foote and Saxton, 1914.)

Gms. per 100 Gms. Sat. Sol.		Solid Phase.	Gms. per 100 Gms. Sat. Sol.		Solid Phase.
NH ₄ Cl.	MnCl ₂ .		NH ₄ Cl.	MnCl ₂ .	
23.97	7.97	α mixed crystals	17.09	18.76	β mixed crystals or double salt 2NH ₄ Cl. MnCl ₂ .2H ₂ O
22.94	9.65		15.05	22.44	
21.44	12.31		13.17	24.52	
21.18	13.38		9.15	29.24	
20.10	15.19		5.90	34.78	
19.70	15.92	α and β mixed crystals	3.77	39.48	2NH ₄ Cl.MnCl ₂ .2H ₂ O + MnCl ₂ .2H ₂ O
19.75	16.02		2.98	43.71	
19.67	15.47		2.94	43.44	

α mixed crystals consist of NH₄Cl with varying amounts of MnCl₂.2H₂O; β mixed crystals consist of the double salt 2NH₄Cl.MnCl₂.2H₂O with excess of NH₄Cl.

This case represents a very rare type of solid solution "in which a single salt and a double salt are each capable of taking up very considerable quantities of the other to form homogeneous mixed crystals."

THE SYSTEM AMMONIUM CHLORIDE + MANGANOUS CHLORIDE + WATER AT 60°.

(Clendinnen and Rivett, 1921.)

d of sat. sol.	Gms. per 100 gms. sat. sol.		Solid Phase.	d of sat. sol.	Gms. per 100 gms. sat. sol.		Solid Phase.
	NH ₄ Cl.	MnCl ₂ .			NH ₄ Cl.	MnCl ₂ .	
1.105	33.52	2.91	Mixed crystals Series AF	1.365	10.52	32.80	Mixed crystals Series GH
1.129	31.93	5.84		1.426	7.55	38.02	
1.183	29.50	10.16		1.482	5.44	43.10	
1.192	27.81	12.95	F and G	1.543	3.93	47.20	H and K
1.200	27.07	13.79		1.575	2.94	49.33	
1.210	25.28	15.91	Mixed crystals Series GH	1.581	2.45	50.92	Mixed crystals Series KD
1.239	22.51	18.81		1.583	2.21	50.68	
1.267	19.04	22.42	Series KD	1.592	1.61	51.16	
1.317	14.33	27.74		1.619	0.91	51.47	

The solid phases lie on the line connecting the compositions of pure ammonium chloride and the dihydrate of manganous chloride. The system is of a somewhat uncommon type. There are three very well-defined series of mixed crystals, namely, AF, GH, and KD with two gaps, FG and HK. The composition of the alleged compound 2NH₄Cl.MnCl₂.2H₂O is well within the second series GH. The authors also give a very complete series of determinations at 25° which supplement those of Foote and Saxton, published in 1914.

In a later paper Clendinnen and Rivett, 1923, give results upon a critical solution temperature for solids in the binary system ammonium chloride-manganous chloride dihydrate. Eight isotherms between 10° and 60° were studied and the results of the analyses of the solutions and wet solid phases are given. The percentage of ammonium chloride in the solution and solid phases were plotted and the isothermal distribution curves thus obtained. These show regions of homogeneous single-phase mixed crystals and also a heterogeneous region. This latter was studied in considerable detail.

More recent determinations on this system of 25° by Benrath and Schackmann, 1935, show that the product which separates from the supersaturated mixture does not reach equilibrium with the solution.

Mn MANGANESE 1002

MANGANESE CHLORIDE $MnCl_2$.

100 gms. sat. solution of manganese chloride in selenium oxychloride ($SeOCl_4$) contain 0.16 gm. $MnCl_2$ at 25°. (Wise, 1923.)

100 gms. pyridine dissolve 1.28 gms. $MnCl_2$ at 0° and 1.06 gms. at 25°. (Müller, R., 1924.)

100 cc anhydrous hydrazine dissolve 13 gms. $MnCl_2$ at about 20°.

(Welsh and Broderson, 1915.)

Fusion-point data are given for:

$MnCl_2 + PbCl_2$ (Sandonnini, 1911, 1914.)

" + $SnCl_2$ (Sandonnini, 1911; Sandonnini and Scarpa, 1911.)

" + $ZnCl_2$ (Sandonnini, 1912, 1914.)

MANGANESE Per CHLORATE $Mn(ClO_4)_2 \cdot 6H_2O$.

SOLUBILITY OF MANGANESE PERCHLORATE IN SEVERAL SOLVENTS AT ABOUT 20°.
(Chaney and Mann, 1911.)

The determinations were made by adding, at room temperature, successive small amounts of solvent to a weighed amount of the salt until, upon vigorous shaking, the last trace of perchlorate just disappeared.

Solvent

Gms. $Mn(ClO_4)_2 \cdot 6H_2O(?)$
per 100 cc solvent

Water

268 (Salvadori, 1912.)

Furfural (C_4H_3OCHO of $d_{25}^{25} = 1.1550$)

90

Cellosolve (Monoethyl ether of ethylene glycol)₁₃₀

MANGANESE Hexa Antipyrine Per CHLORATE $Mn(COC_{10}H_{12}N_2)_6 \cdot (ClO_4)_2$.

100 cc sat. solution of the salt in water contain 3.63 gm.

$Mn(COC_{10}H_{12}N_2)_6 \cdot (ClO_4)_2$ at 20°. (Wilke-Dörfurt and Schliephake, 1929.)

MANGANESE FLUORIDE $MnF_2 \cdot (4H_2O?)$.

SOLUBILITY OF MANGANESE FLUORIDE IN WATER.
(Nuka, 1929.)

t°

Gms. MnF_2 per 100 gms. sat. sol.

Solid Phase

20

1.05

$MnF_2 \cdot 4H_2O$

40

0.66

?

60

0.44

?

100

0.48

?

25

0.186 gm. per 100cc sat. sol. (Carter, 1928.)

SOLUBILITY OF MANGANESE FLUORIDE IN AQUEOUS SOLUTIONS OF
HYDROFLUORIC ACID AT 20°.
(Kurténacker, Finger and Hey, 1933.)

Gms. per 100 gms. sat. sol.

HF

MnF_2

Solid

Phase

5.28

2.88

MnF_2

17.05

3.73

"

36.42

0.72

"

MANGANESE Hexa Antipyrine Boro FLUORIDE $[\text{Mn}(\text{COC}_{10}\text{H}_{12}\text{N}_2)_6](\text{BF}_4)_2$.

100 cc. sat. solution of Manganese Hexa Antipyrine Boro Fluoride in water contain 5.4 gms. $[\text{Mn}(\text{COC}_{10}\text{H}_{12}\text{N}_2)_6](\text{BF}_4)_2$ at 20°.

(Wilke-Dörfurt and Mureck, 1929.)

MANGANESE Ammonium FLUORIDE MnNH_4F_3 .

100 gms. sat. solution of Manganese Ammonium Fluoride in Water contain 1.2 gm. MnNH_4F_3 at 20°. (Nuka, 1929.)

MANGANESE Silico FLUORIDE $\text{MnSiF}_6 \cdot 6\text{H}_2\text{O}$.

F

100 gms. H_2O dissolve 140 gms. of the salt at 17.5°. Sp. Gr. of the solution = 1.448. (Stolba, 1883.)

MANGANESE Pyridine etc. FLUORIDES.

SOLUBILITY OF EACH SEPARATELY IN ETHYL ALCOHOL AND
IN ACETIC ACID AT 20°.

(Olsson, 1930.)

An excess of each compound was shaken with the solvent and the saturated solution analyzed for manganese by reduction with SO_2 and precipitating as manganese ammonium phosphate and weighing as the pyrophosphate.

Compound	Formula	Gms. Compound (7H ₂ O of Cryst.) per 100 cc sat. solution in:	
		$\text{C}_2\text{H}_5\text{OH}$	CH_3COOH
Manganese:			
Pyridine Tetra Fluoride	$\text{C}_5\text{H}_5\text{NHMnF}_4 \cdot \text{H}_2\text{O}$	0.729	3.926
Quinoline "	$\text{C}_9\text{H}_7\text{NHMnF}_4 \cdot 3\text{H}_2\text{O}$	1.560	15.456
Tetra methyl ammonium "	$(\text{CH}_3)_4\text{NMnF}_4 \cdot 2\text{H}_2\text{O}$	0.289	4.326
Ethylene di amine penta "	$\text{C}_2\text{H}_4(\text{NH}_2)_2\text{H}_2\text{MnF}_5 \cdot (\text{H}_2\text{O}?)$	0.003	0.102
Guanidine tetra "	$\text{CNH}(\text{NH}_2)_2\text{H MnF}_4 \cdot 3\text{H}_2\text{O}$	0.029	0.449
" penta "	$[\text{CNH}(\text{NH}_2)_2\text{H}]_2\text{MnF}_5$	0.013	0.053

MANGANESE IODIDE MnI_2 .

I

100 gms. Liquid Ammonia dissolve 0.02 gm. MnI_2 at 0°. (Hunt and Boncyk, 1933.)

MANGANESE Mercuric IODIDE $3\text{MnI}_2 \cdot 5\text{HgI}_2 \cdot 20\text{H}_2\text{O}$.

A saturated solution of the salt in water at 17° has the composition 1.4 $\text{MnI}_2 \cdot \text{HgI}_2 \cdot 10.22\text{H}_2\text{O}$ and density 2.98. (Duboin, 1906.)

MANGANESE Ammonium MOLYBDATE $\text{Mn}_2(\text{Mo}_2\text{O}_7)_3 \cdot 5(\text{NH}_4)_2\text{MoO}_4 \cdot 12\text{H}_2\text{O}$.

100 gms. H_2O dissolve 0.98 gms. of the salt at 17°. (Struve, 1854.)

MANGANESE NITRATE $\text{Mn}(\text{NO}_3)_2$.

SOLUBILITY IN WATER.

(Funk — Wiss. Abh. p. t. Reichenstalt 3, 438, '00.)

t°.	Gms. $\text{Mn}(\text{NO}_3)_2$ per 100 Gms. Sol.	Mols. $\text{Mn}(\text{NO}_3)_2$ per 100 Mols. H_2O .	Solid Phase.	t°.	Gms. $\text{Mn}(\text{NO}_3)_2$ per 100 Gms. Sol.	Mols. $\text{Mn}(\text{NO}_3)_2$ per 100 Mols. H_2O .	Solid Phase.
-29	42.29	7.37	$\text{Mn}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$.	18	57.33	13.5	$\text{Mn}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$.
-26	43.15	7.63	"	25	62.37	16.7	"
-21	44.30	8.0	"	27	65.66	19.2	$\text{Mn}(\text{NO}_3)_2 \cdot 3\text{H}_2\text{O}$.
-16	45.52	8.4	"	29	66.99	20.4	"
-5	48.88	9.61	"	30	67.38	20.7	"
0	50.49	10.2	"	34	71.31	24.9	"
+11	54.50	12.0	"	35.5	76.82	33.3	"

Sp. Gr. of solution saturated at $18^\circ = 1.624$.The Eutec is at -36° and 40.5 gms. $\text{Mn}(\text{NO}_3)_2$ per 100 gms. Sat. Sol.

100 gms. sat. solution of $\text{Mn}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$ in water contain 56.81 gms. $\text{Mg}(\text{NO}_3)_2$ at 20° . (di Capua, 1929.)

MANGANESE OXIDE MnO .

Fusion-point data for mixtures of manganese oxide and silicic acid are given by Doernickel, 1907.

MANGANESE HYDROXIDE $\text{Mn}(\text{OH})_2$.One liter H_2O dissolves $2.15 \cdot 10^{-4}$ gms. mols. $\text{Mn}(\text{OH})_2$ at 18° .

(Sackur and Fritzmann, 1909.)

One liter H_2O dissolves $2.10 \cdot 10^{-4}$ gms. mols. $\text{Mn}(\text{OH})_2$ at 18° .

(Tamm, 1910.)

The determination of S. & F. was made by the neutralization method of Kuster, that is, by determining the conductivity minimum on adding $\text{Ba}(\text{OH})_2$ to MnSO_4 solution and calculating the $\text{Mn}(\text{OH})_2$ remaining in solution.

SOLUBILITY OF MANGANESE HYDROXIDE IN AQUEOUS SOLUTIONS OF ORGANIC SALTS.

(Tamm, 1910.)

(25 cc. of the neutral salt solution + 25 cc. of aqueous suspension of $\text{Mn}(\text{OH})_2$ were shaken different lengths of time. Temp. not stated.)

100 cc. sat. solution in 1 N sodium tartrate solution contain 0.052 gm. Mn_2O_4 .100 cc. sat. solution in 1 N sodium malate solution contain 0.032 gm. Mn_2O_4 .100 cc. sat. solution in 1 N sodium citrate solution contain 0.095 gm. Mn_2O_4 .**MANGANESE HYDROXIDE** $\text{MnO}(\text{OH})_2$.

One liter ordinary distilled water containing a little CO_2 dissolves 0.00043 gm. $\text{MnO}(\text{OH})_2$ at about 22° . (Almkvist, 1918.)

MANGANESE (Hypo) PHOSPHITE $\text{Mn}(\text{PH}_2\text{O}_2)_2 \cdot \text{H}_2\text{O}$.100 gms. H_2O dissolve 15.15 gms. salt at 25° , and 16.6 gms. at b. pt. (U. S. P.)

EQUILIBRIUM IN THE SYSTEM MANGANESE PHOSPHATE, PHOSPHORIC ACID AND WATER.

(Grube and Stasche, 1927.)

Results at 25°

Normality of Aq. H_3PO_4 solvent	Gms. per 100 gms. sat. solution		Solid Phase
	H_3PO_4	$Mn_3(PO_4)_2$	
1.0	2.61	1.36	$Mn_3(PO_4)_2$
2.0	5.23	3.72	"
2.98	7.60	5.37	"
3.54	8.56	5.88	$MnHPO_4$
6.09	14.02	10.36	"
9.00	19.98	13.74	"
9.29	21.07	14.59	"
11.00	25.32	17.33	"
15.25	28.02	19.55	$H_4[Mn(PO_4)_2]$
17.96	29.90	17.21	" $.3H_2O$
20.95	42.78	11.07	"
24.07	49.76	8.43	"
29.42	56.29	6.07	"
34.78	64.51	3.97	"
39.93	74.62	2.46	"
44.79	82.05	2.38	"
50.00	85.95	0.0	H_3PO_4

Results at 55°

Normality of Aq. H_3PO_4 solvent	Gms. per 100 gms. sat. solution		Solid Phase
	H_3PO_4	$Mn_3(PO_4)_2$	
3.0	8.92	7.14	$Mn_3(PO_4)_2$
4.5	13.35	10.50	"
6.0	16.75	14.16	"
9.0	21.67	18.10	"
12.0	27.30	24.50	$MnHPO_4$
13.5	31.30	27.13	"
15.0	32.40	28.70	"
18.0	36.00	30.90	"
21.0	41.40	24.60	$H_4[Mn(PO_4)_2]$
27.0	57.30	13.30	" $.3H_2O$
36.0	69.00	7.70	"
45.0	83.30	7.30	"

PO

MANGANESE Ammonium PHOSPHATE $MnNH_4PO_4 \cdot 7H_2O$.

1000 cc. sat. solution of Manganese Ammonium Phosphate in Water contain 0.00042 gm. $MnNH_4PO_4 \cdot H_2O$. (? temp.) (Breuner, 1920, 1922.)

SOLUBILITY OF MANGANESE AMMONIUM PHOSPHATE IN SEVERAL SOLVENTS.

(Wenger, 1911.)

Gms. NH_4MnPO_4 per 100 Gms. Solvent in:

t°.	Water.	Aq. 5% NH_4NO_3 .	Aq. 5% NH_4Cl .	Mixture of 1 Pt. NH_3 ($d=0.96$) + 4 parts H_2O .
0	...	0.021	0.002	0.0116
20	0	0.020	0.025	0.0122
30	...	0.023	0.034	...
40	0	0.021	0.039	0.0118
50	...	0.023	0.035	0.0132
60	0	0.027	0.038	0.0194
70	0.005	0.028	0.041	0.0191
80	0.007	0.033	0.045	0.0197

MANGANESE SULFIDE MnS .

S

One liter sat. solution in water contains $71.6 \cdot 10^{-6}$ mols. $MnS = 0.00623$ gm. per liter at 18° by conductivity method. (Weigel, 1907; see also Bruner and Zawadzki, 1909.)

Purified manganese sulfide was agitated in 0.01 $N H_2SO_4$ containing H_2S for 10 hours at 20°. The determination was repeated after another period of 10 hours. The sat. solution contained 0.4874 gm. MnS , corresponding to $5.6 \cdot 10^{-3}$ gm. mols. MnS , per 1000 cc.

(Moser and Behr, 1924.)

Attention is called by Kolthoff, 1931, to the incorrectness of the results of Weigel. From a critical study of the available determinations of the solubility of metal sulfides in water, it is concluded that these results are of doubtful value, and it is recommended that the relation between the solubility and the hydrogen ion and hydrogen sulfide concentrations be expressed as the reaction constant.

MANGANESE SULFATE MnSO_4 .

SOLUBILITY IN WATER.

(Cottrell — J. Physic. Ch. 4, 651, '01; Richards and Fraprie — Am. Ch. J. 26, 77, '01. The results of Linebarger — Am. Ch. J. 15, 225, '93, were shown to be incorrect by Cottrell, and this conclusion was confirmed by R. and F.)

t°.	Grams MnSO_4 per 100 Gms.		Solid Phase.	t°.	Grams MnSO_4 per 100 Gms.		Solid Phase.
	Water.	Solution.			Water.	Solution.	
-10	47.06	32.40	$\text{MnSO}_4 \cdot 7\text{H}_2\text{O}$	16	63.94	38.99	$\text{MnSO}_4 \cdot 4\text{H}_2\text{O}$
0	53.23	34.73	"	18.5	64.19	39.10	"
5	56.24	35.99	"	25	65.32	39.53	"
9	59.33	37.24	"	30	66.44	39.93	"
12	61.77	38.19	"	39.9	68.81	40.77	"
14.3	63.93	39.00	"	49.9	72.63	42.08	"
5	58.06	36.69	$\text{MnSO}_4 \cdot 5\text{H}_2\text{O}$	41.4	60.87	37.84	$\text{MnSO}_4 \cdot \text{H}_2\text{O}$
9	59.19	37.18	"	50	58.17	36.76	"
15	61.08	37.91	"	60	55.0	35.49	"
25	64.78	39.31	"	70	52.0	34.22	"
30	67.76	40.38	"	80	48.0	32.43	"
35.5	71.61	41.74	"	90	42.5	29.83	"
				100	34.0	24.24	"

More recent very careful determinations of the Solubility of Manganese Sulfate in Water by Krepelka and Rejha, 1933, gave the following values, differing in certain details from the above.

t°	Gms. MnSO_4 per 100 gms. sat. sol.	Solid Phase	t°	Gms. MnSO_4 per 100 gms. sat. sol.	Solid Phase
-5	23.3	Ice	20	39.1*	$\text{MnSO}_4 \cdot 4\text{H}_2\text{O}$
-10	31.3		23.5 tr.pt.	39.4*	" + $\text{MnSO}_4 \cdot \text{H}_2\text{O}$
-11.4 Eutec.	32.2		30	39.7*	"
-5	33.4	$\text{MnSO}_4 \cdot 7\text{H}_2\text{O}$	35	40.3*	"
0	34.6	"	45	41.4*	"
+5	36.1	"	10	40.6*	$\text{MnSO}_4 \cdot \text{H}_2\text{O}$
8.6 tr.pt.	37.2	" + $\text{MnSO}_4 \cdot 5\text{H}_2\text{O}$	20	39.7*	"
10	37.8*	"	25	39.2	"
5	36.8*	$\text{MnSO}_4 \cdot 5\text{H}_2\text{O}$	30	38.6	"
15(1.4772)	38.0	"	40	37.5	"
20(1.4866)	38.6	"	50	36.3	"
24.5	39.3	" + $\text{MnSO}_4 \cdot \text{H}_2\text{O}$	60	34.9	"
25(1.4993)	39.4*	" + $\text{MnSO}_4 \cdot 4\text{H}_2\text{O}$	70	38.2	"
30	40.4*	"	80	31.3	"
35	41.5*	"	90	29.0	"
15	38.8*	$\text{MnSO}_4 \cdot 4\text{H}_2\text{O}$	100.7 b. pt.	26.1	"

* Metastable.

The figures in parentheses are densities of the saturated solutions, determined by Flöttmann, 1928.

MANGANESE SULFATE

SOLUBILITY OF MANGANESE SULFATE IN AQUEOUS SOLUTIONS
OF SULFURIC ACID AT 12.6°.
(Montemartini and Losana, 1928.)

d. of	Gms. per 100 gms. sat. sol.		Solid Phase	d. of	Gms. per 100 gms. sat. sol.		Solid Phase
sat. sol.	H ₂ SO ₄	MnSO ₄		sat. sol.	H ₂ SO ₄	MnSO ₄	
1.4817	0.0	36.98	MnSO ₄ ·5H ₂ O	1.3782	47.64	2.10	MnSO ₄ ·H ₂ O·MnSO ₄
1.4312	10.06	29.65	MnSO ₄ ·4H ₂ O	1.4640	52.21	0.61	MnSO ₄
1.4181	17.45	24.93	"	1.4618	67.42	0.41	MnSO ₄ ·H ₂ SO ₄ ·H ₂ O
1.3862	23.82	18.07	"	1.6579	75.76	0.21	"
1.3628	32.21	8.03	" + MnSO ₄ ·H ₂ O	1.7748	85.52	0.11	MnSO ₄ ·H ₂ SO ₄
1.3561	40.51	4.20	MnSO ₄ ·H ₂ O	1.8442	99.12	0.05	MnSO ₄ ·3H ₂ O

SOLUBILITY OF MANGANESE SULFATE IN AQUEOUS SOLUTIONS OF
AMMONIUM SULFATE AT 25° AND 50° AND VICE VERSA.
(Schreinemakers, 1909.)

Results at 25°.

Results at 50°.

Gms. per 100 Gms.	Solid Phase.	
Sat. Sol.		
MnSO ₄	(NH ₄) ₂ SO ₄	
39.3	0	MnSO ₄ ·5H ₂ O
38.49	3.64	" + D ₄
33.44	4.91	D ₄
22.06	9.65	"
9.02	20.36	"
2.91	37.42	"
1.75	42.58	" + (NH ₄) ₂ SO ₄
1.77	43.24	(NH ₄) ₂ SO ₄
0	43.4	"

D₄ = MnSO₄·(NH₄)₂SO₄·6H₂O.

Gms. per 100 Gms.	Solid Phase.	
Sat. Sol.		
MnSO ₄	(NH ₄) ₂ SO ₄	
36.26	0	MnSO ₄ ·H ₂ O
35.35	2.95	" + D _{2.1}
30.57	5.14	D _{2.1}
16.86	17.62	"
6.02	35.08	"
6.20	39.71	"
5.70	43.24	" + (NH ₄) ₂ SO ₄
3.49	44.02	(NH ₄) ₂ SO ₄
0	45.7	"

D_{2.1} = (MnSO₄)₂·(NH₄)₂SO₄.

SO

SOLUBILITY OF MANGANESE SULFATE IN AQUEOUS SOLUTIONS
OF AMMONIUM SULFATE AND VICE VERSA AT 0°.

(Caven and Johnston, 1977.)

Gm. Mols. per 1000 gms. H ₂ O	Solid Phase		Gm. Mols. per 1000 gms. H ₂ O	Solid Phase	
(NH ₄) ₂ SO ₄			(NH ₄) ₂ SO ₄		
0.0		MnSO ₄ ·7H ₂ O	1.864	0.377	1.1.6
0.168			3.551	0.167	"
0.251		" + 1.1.6	3.993	0.138	"
0.260		1.1.6	5.135	0.075	"
0.531		"	5.229	0.081	" + (NH ₄) ₂ SO ₄
1.069		"	5.254	0.017	(NH ₄) ₂ SO ₄
1.315		"	5.327	0.0	"

1.1.6 = MnSO₄·(NH₄)₂SO₄·6H₂O.

SOLUBILITY OF MANGANESE SULFATE IN AQUEOUS SOLUTIONS
OF AMMONIUM SULFATE AND VICE VERSA.

(Benrath, 1931a.)

Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase
$(\text{NH}_4)_2\text{SO}_4$	MnSO_4		$(\text{NH}_4)_2\text{SO}_4$	MnSO_4	

Results at 12.5°			Results at 40° (con.)		
3.17	36.9	$\text{MnSO}_4 \cdot 5\text{H}_2\text{O} + 1.1.6$	29.7	7.99	1.1.6
3.24	34.91	1.1.6	40.75	4.26	"
21.23	3.29	"	41.81	3.80	" + $(\text{NH}_4)_2\text{SO}_4$
41.75	1.2	" + $(\text{NH}_4)_2\text{SO}_4$	Results at 100°		

Results at 40°			Results at 100°		
1.76	37.39	$\text{MnSO}_4 \cdot \text{H}_2\text{O}$	3.45	25.96	$\text{MnSO}_4 \cdot \text{H}_2\text{O} + 2.1$
4.84	35.23	2.1	3.91	23.81	2.1
7.6	31.32	"	5.49	18.47	"
10.33	28.61	"	10.62	10.04	"
17.8	17.89	1.1.6	25.35	5.15	"
19.98	14.77	"	39.19	2.83	"
			50.15	1.66	" + $(\text{NH}_4)_2\text{SO}_4$

1.1.6 = $\text{MnSO}_4 \cdot (\text{NH}_4)_2\text{SO}_4 \cdot 6\text{H}_2\text{O}$; 2.1 = $2\text{MnSO}_4 \cdot (\text{NH}_4)_2\text{SO}_4$.

MANGANESE Ammonium SULFATE $\text{MnSO}_4 \cdot (\text{NH}_4)_2\text{SO}_4 \cdot 6\text{H}_2\text{O}$.

SO

100 cc Water dissolve 37.2 gms. $\text{MnSO}_4 \cdot (\text{NH}_4)_2\text{SO}_4$, at 25°. (Locke, 1901.)
100 cc sat. solution of manganese ammonium sulfate in water contain
38.28 gms. $\text{MnSO}_4 \cdot (\text{NH}_4)_2\text{SO}_4 \cdot 6\text{H}_2\text{O}$ at 7°. (Bertisch, 1926.)

SOLUBILITY OF MANGANESE SULFATE IN AQUEOUS SOLUTIONS OF SODIUM
SULFATE AT 35° AND VICE VERSA.

(Schreinemakers and Provijs, 1913.)

Gms. per 100 Gms. Sat. Sol.		Solid Phase.	Gms. per 100 Gms. Sat. Sol.		Solid Phase.
MnSO_4	Na_2SO_4		MnSO_4	Na_2SO_4	
39.45	0	$\text{MnSO}_4 \cdot \text{H}_2\text{O}$	13.96	21.91	$(\text{MnSO}_4)_9 \cdot (\text{Na}_2\text{SO}_4)_{10}$ + $\text{MnSO}_4 \cdot (\text{Na}_2\text{SO}_4)_2$
33.92	5.23	"	12.10	22.49	$\text{MnSO}_4 \cdot (\text{Na}_2\text{SO}_4)_2$
33.06	7.97	" + $(\text{MnSO}_4)_9 \cdot (\text{Na}_2\text{SO}_4)_{10}$	10.45	23.41	"
32.92	7.42	"	7.43	26.58	"
31.05	9.20	$(\text{MnSO}_4)_9 \cdot (\text{Na}_2\text{SO}_4)_{10}$	5.69	29.31	"
27.67	10.76	"	5.11	30.52	" + Na_2SO_4
22.14	14.28	"	2.96	31.33	
14.58	20.01	"	0	33	

Data for the solubility of mix crystals of manganese and zinc sulfates between 0° and 39° are given by Sahmen, 1905-06.

MANGANESE SULFATE

SOLUBILITY OF MANGANESE SULFATE IN AQUEOUS SOLUTIONS
OF SODIUM SULFATE AND VICE VERSA AT 0°.

(Caven and Johnston, 1928.)

Gm. Mols. per 1000 gms. H ₂ O		Solid Phase	Gm. Mols. per 1000 gms. H ₂ O		Solid Phase
MnSO ₄	Na ₂ SO ₄		MnSO ₄	Na ₂ SO ₄	
3.533	0.0	MnSO ₄ ·7H ₂ O	1.650	0.445	Na ₂ SO ₄ ·10 H ₂ O
3.499	0.158	"	0.897	0.383	"
3.424	0.509	"	0.773	0.389	"
3.413	0.566	" + Na ₂ SO ₄ ·10H ₂ O	0.254	0.369	"
2.818	0.520	Na ₂ SO ₄ ·10H ₂ O	0.0	0.331	"

SOLUBILITY OF MANGANESE SULFATE IN AQUEOUS SOLUTIONS
OF SODIUM SULFATE AND VICE VERSA AT 25° AND AT 35°.

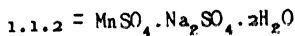
(Caven and Johnston, 1928.)

Results at 25°

Gms. per 100 gms. sat. sol.		Solid Phase
MnSO ₄	Na ₂ SO ₄	
39.10	0.0	MnSO ₄ ·4H ₂ O
38.43	1.66	"
36.94	5.09	" + 1.1.2
34.69	6.23	1.1.2
29.52	8.78	"
22.88	13.51	"
18.62	17.42	"
17.15	19.26	" + Na ₂ SO ₄ ·10H ₂ O
15.15	19.55	Na ₂ SO ₄ ·10H ₂ O
9.14	20.53	"
5.44	21.16	"
2.81	21.54	"
0.0	21.89	"

Results at 35°

Gms. per 100 gms. sat. sol.		Solid Phase
MnSO ₄	Na ₂ SO ₄	
39.56	0.0	MnSO ₄ ·H ₂ O
37.12	3.05	"
34.46	6.62	" + 1.1.2
30.43	8.49	1.1.2
26.56	11.12	"
15.64	19.79	"
12.54	22.96	"
10.21	25.75	"
9.35	27.49	" + Na ₂ SO ₄
6.55	29.05	Na ₂ SO ₄
4.25	30.49	"
0.0	32.83	"



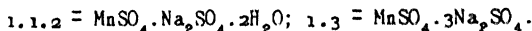
The above results at 35° fail to confirm the existence of the double salts. $\text{MnSO}_4 \cdot 3\text{Na}_2\text{SO}_4$ and $9\text{MnSO}_4 \cdot 10\text{Na}_2\text{SO}_4$ previously reported by Schreinemakers and Provijs, 1913, or of $\text{MnSO}_4 \cdot \text{Na}_2\text{SO}_4 \cdot 4\text{H}_2\text{O}$.

MANGANESE SULFATE

 SOLUBILITY OF MANGANESE SULFATE IN AQUEOUS SOLUTIONS
 OF SODIUM SULFATE AT SEVERAL TEMPERATURES.
 (Benrath, 1929a.)

t°	Gms. per 100 gms. sat. sol.		Solid Phase	t°	Gms. per 100 gms. sat. sol.		Solid Phase
	Na ₂ SO ₄	MnSO ₄			Na ₂ SO ₄	MnSO ₄	
11	7.52	33.50	MnSO ₄ ·5H ₂ O+1.1.2	50	9.95	29.25	1.1.2
"	10.45	29.0	Na ₂ SO ₄ ·10H ₂ O+	"	12.45	24.89	"
			1.1.2	"	13.59	22.42	"
25	28.64	8.62*	1.3	"	16.42	18.33	"
30	27.64	6.40	" + Na ₂ SO ₄ ·10H ₂ O	"	17.17	17.53	" + 1.3
41	7.52	32.28	MnSO ₄ ·H ₂ O+1.1.2	"	18.62	14.91	1.3
"	18.09	17.13	1.3 + 1.1.2	"	20.78	11.59	"
"	24.73	7.93	"	"	23.04	7.84	"
"	34.38	2.50	" + Na ₂ SO ₄	"	25.99	5.16	"
50	0.0	37.3	MnSO ₄ ·H ₂ O	"	27.76	3.09	"
"	4.70	33.22	"	"	30.2	2.68	" + Na ₂ SO ₄
"	7.09	31.60	"	"	31.8	0.0	Na ₂ SO ₄
"	8.57	30.95	"				

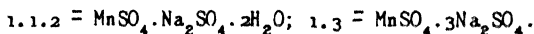
SO



The author considers that Caven and Johnston, 1928, failed to find the 1.3 salt on account of the slowness with which it is formed in the vicinity of its transformation points.

 SOLUBILITY OF MANGANESE SULFATE IN AQUEOUS SOLUTIONS
 OF SODIUM SULFATE AT 97°.
 (Benrath and Benrath, 1929.)

d. of sat. sol.	Gms. per 100 gms. sat. sol.		Solid Phase	d. of sat. sol.	Gms. per 100 gms. sat. sol.		Solid Phase
	Na ₂ SO ₄	MnSO ₄			Na ₂ SO ₄	MnSO ₄	
1.216	0.0	28.49	MnSO ₄ ·H ₂ O	1.304	14.89	18.54	1.3
1.244	2.16	26.48	"	1.263	15.93	14.77	"
1.275	4.91	24.60	"	1.249	16.87	12.48	"
—	11.42	22.84	"	1.241	17.90	10.42	"
—	11.94	22.81	" + 1.1.2	1.216	19.43	6.79	"
1.326	12.64	22.09	" + "	1.215	23.53	2.58	"
1.317	13.13	21.41	1.1.2	—	25.38	1.41	"
1.329	13.70	20.49	"	1.230	29.54	0.69	" + Na ₂ SO ₄
1.339	14.72	19.25	" + 1.3	1.237	29.85	0.0	Na ₂ SO ₄



MANGANESE SULFATE

SOLUBILITY OF MANGANESE SULFATE IN AQUEOUS SOLUTIONS
OF RUBIDIUM SULFATE AND VICE VERSA.

(Benrath, 1931a.)

t°	Gms. per 100 gms. sat. sol.		Solid Phase	t°	Gms. per 100 gms. sat. sol.		Solid Phase
	Rb ₂ SO ₄	MnSO ₄			Rb ₂ SO ₄	MnSO ₄	
0	4.8	33.4	MnSO ₄ ·7H ₂ O + 1.1.6	55	3.58	29.0	2.1
"	8.95	9.3	1.1.6	"	5.77	20.56	"
"	10.83	6.32	"	"	10.55	11.60	"
"	26.51	1.69	" + Rb ₂ SO ₄	"	23.95	5.72	"
25	3.3	37.5	MnSO ₄ ·H ₂ O + 1.1.6	"	30.75	4.08	"
"	10.67	26.93	1.1.6	75	2.97	30.8	MnSO ₄ ·H ₂ O + 2.1
"	32.73	3.77	" + Rb ₂ SO ₄	"			
"	33.47	3.03	" + "	"	2.81	29.25	2.1
40	5.50	32.05	2.1	"	9.61	7.59	"
"	6.17	24.02	"	"	26.48	2.31	"
"	13.21	14.8	"	"	45.56	2.12	"
"	25.34	7.72	"	100	2.26	22.65	"
"	33.49	5.11	"	"	9.09	3.91	"
60	39.75	3.17	" + Rb ₂ SO ₄	"	20.74	1.76	"
				"	31.96	1.34	"

1.1.6 = MnSO₄·Rb₂SO₄·6H₂O; 2.1 = 2MnSO₄·Rb₂SO₄.

SO

SOLUBILITY OF MANGANESE SULFATE IN AQUEOUS SOLUTIONS
OF THORIUM SULFATE AND VICE VERSA AT 30°.

(Caven, 1932.)

Gms. per 100 gms. H ₂ O	Solid Phase	Gms. per 100 gms. H ₂ O	Solid Phase
Th(SO ₄) ₂	MnSO ₄	Th(SO ₄) ₂	MnSO ₄
0.0	66.41 MnSO ₄ ·5H ₂ O	7.91	13.79 1.1.7 + Th(SO ₄) ₂ ·8H ₂ O
0.135	65.67 " + 1.1.7	8.66	17.68* Th(SO ₄) ₂ ·8H ₂ O
0.50	54.59 1.1.7	8.23	15.49* "
1.38	45.27 "	7.75	13.54 "
1.87	36.78 "	6.64	9.33 "
3.11	29.75 "	4.69	4.54 "
5.82	19.86 "	3.94	2.93 "
5.65	16.94 "	3.03	1.41 "
		2.14	0.0 "

* = Metastable

1.1.7 = MnSO₄·Th(SO₄)₂·7H₂O. This double salt forms very slowly and could only be obtained by preparing a hot concentrated solution of thorium and manganese sulfates and stirring this for a long period at 30°. It cannot be recrystallized from H₂O.

MANGANESE SULFATE

SOLUBILITY OF MANGANESE SULFATE IN AQUEOUS SOLUTIONS
OF THALLIUM SULFATE.

(Benrath, 1931a.)

t°	Gms. per 100 gms. sat. sol.		Solid Phase	t°	Gms. per 100 gms. sat. sol.		Solid Phase
	Tl ₂ SO ₄	MnSO ₄			Tl ₂ SO ₄	MnSO ₄	
0	3.26	34.4	MnSO ₄ ·7H ₂ O+1.1.6	40	3.62	36.78	MnSO ₄ ·H ₂ O+2.1
"	9.85	3.88	Tl ₂ SO ₄ + "	"	5.43	27.92	2.1
8	6.0	14.2	" + "	"	13.05	21.85	" + Tl ₂ SO ₄
25	3.2	38.6	MnSO ₄ ·5H ₂ O+2.1	66	2.06	34.57	MnSO ₄ ·H ₂ O+2.1
30	2.52	38.42	MnSO ₄ ·H ₂ O + "	"	5.84	20.24	2.1
"	7.39	28.91	2.1	"	7.65	15.01	"
"	9.32	31.21	1.1.6	"	11.81	9.07	"
"	11.08	27.14	2.1 + TlSO ₄	"	14.75	8.85	" + Tl ₂ SO ₄
50	2.83	35.41	MnSO ₄ ·H ₂ O+2.1	"	12.80	7.23	Tl ₂ SO ₄
"	4.58	30.14	2.1	100	2.33	24.17	MnSO ₄ ·H ₂ O+2.1
"	9.07	22.45	"	"	4.75	7.56	2.1
"	13.38	13.77	" + Tl SO	"	7.25	4.29	"
"	11.37	8.50	Tl SO	"	16.06	2.49	"
"	10.08	4.38	"	"	17.28	2.14	" + Tl ₂ SO ₄

SO

1.1.6 = MnSO₄·Tl₂SO₄·6H₂O; 2.1 = 2MnSO₄·Tl₂SO₄.EQUILIBRIUM IN THE SYSTEM MANGANESE SULFATE, ZINC
SULFATE AND WATER AT 35°.

(Benrath and Blankenstein, 1934a.)

The results are expressed in the Jänecke System in terms of the gm. mols. H₂O to dissolve 1.0 gm. mol. anhydrous salt mixture containing the reported percentage of MnSO₄. Results for the isotherms 0°, 20°, 23°, 27.2°, 30°, 35°, 45° and 60° are given. Both the saturated solutions and moist solids were analyzed and the composition of the solid phase deduced from the results. The solid phases of mixed crystals over considerable regions and the limiting percentage of the constituents in these are shown. The following values at 35° are typical of the entire series.

Percent MnSO ₄ in 1 mol. dissolved salt mixture	Mols. H ₂ O to dissolve 1 mol. salt mixture	Crystalline Phase	Percent MnSO ₄ in mol. dissolved salt mixture	Mols. H ₂ O to dissolve 1 mol. salt mixture	Crystalline Phase
100.0	13.53	MnSO ₄ ·H ₂ O	41.8	11.5	MnSO ₄ ·5H ₂ O
93.6 (98.1)	13.2 (1.0)	"	38.0	11.4	" + ZnSO ₄ ·6H ₂ O
81.6	12.5	"	37.8 (15.0)	12.0 (6.0)	ZnSO ₄ ·6H ₂ O
70	12.1	"	34.0	11.8	"
59.6	11.63	" + MnSO ₄ ·5H ₂ O	22.2 (5.5)	12.4 (7.0)	ZnSO ₄ ·7H ₂ O
49.9	11.5	MnSO ₄ ·5H ₂ O	15.9	12.9	"
43.3 (61.0)	11.3 (5.0)	"	5.69	13.3	"
			0.0	13.5	"

The figures in parentheses are the limiting values respectively for MnSO₄·H₂O, MnSO₄·5H₂O, ZnSO₄·6H₂O and ZnSO₄·7H₂O in the mixed crystals composing the moist solid phases.

SOLUBILITY OF MANGANESE SULFATE IN AQUEOUS ETHYL ALCOHOL.
(Schreinemakers, 1909; Schreinemakers and Deuse, 1912.)

Results at 25°.			Results at 50°.		
Gms. per 100	Gms. Sat. Sol.	Solid Phase.	Gms. per 100	Gms. Sat. Sol.	Solid Phase.
$C_2H_5OH.$	$MnSO_4.$		$C_2H_5OH.$	$MnSO_4.$	
0	39.3	$MnSO_4 \cdot 5H_2O$	0	36.26	$MnSO_4 \cdot 5H_2O$
6.81	33.72	"	6.67	28.12	"
liquid layers separate here			16.02	18.75	"
53.09	1.23	"	22.63	12.54	"
57.39	0.56	"	36.47	4.12	"
76.70	0	$MnSO_4 \cdot H_2O$			

Composition of the liquid layers.

The following reciprocally saturated metastable solutions were obtained at 50°.

Water rich Layer.		C_2H_5OH rich Layer.		Water rich Layer.		C_2H_5OH rich Layer.	
% $C_2H_5OH.$	% $MnSO_4.$	% $C_2H_5OH.$	% $MnSO_4.$	% $C_2H_5OH.$	% $MnSO_4.$	% $C_2H_5OH.$	% $MnSO_4.$
6.81	33.72*	53.09	1.23*	5.68	34.95	53.64	0.97
8.48	31.51	49.76	1.83	7.69	30.99	45.83	2.19
15.02	22.61	32.75	8.01	8.70	29.20	41.93	3.11
				11.85	24.84	35.15	5.95

* These liquids in contact with $MnSO_4 \cdot 5H_2O$.

Similar data are also given for 30° and for 35°. Both stable and metastable liquid pairs were obtained at these intermediate temperatures.

Additional data for this system are also given by Cuno, 1908.

SO

SOLUBILITY OF MANGANESE SULFATE IN AQUEOUS ETHYL ALCOHOL (CON.).

Composition of the conjugated liquids in contact with excess of solid salt.

t°.	C_2H_5OH rich Layer.		Aqueous rich Layer.		Solid Phase.
	% $C_2H_5OH.$	% $MnSO_4.$	% $C_2H_5OH.$	% $MnSO_4.$	
10	37.06	5.44	13.78	25.25	$MnSO_4 \cdot 5H_2O$
15	44.56	2.79	9.25	29.79	"
17	47.11	2.22	8.53	30.88	"
21	53.55	1.10	6.10	35.05	"
25	53.09	1.23	6.81	33.72	"
30	45.20	2.49	8.69	30.15	$MnSO_4 \cdot H_2O$
31	43.90	2.74	8.47	30.10	"
35	41.71	3.44	9.24	28.61	"
37	38.26	4.84	11.03	26.47	"
41	34.01	5.86	11.93	24.97	"
42	32.37	6.89	13.57	23.09	"
43	31.42	8.51	14.33	22.01	"

Data for the solubility of manganese sulfate and potassium iodate in methyl alcohol are given by Karplus, 1907.

SOLUBILITY OF MANGANESE SULFATE IN AQUEOUS ETHYL AND PROPYL ALCOHOL SOLUTIONS AT 20°.
(Linebarger, 1892; Snell, 1898.)

Conc. of Alcohol in Wt. per cent.	Gms. $MnSO_4$ per 100 Gms. Aq.		Conc. of Alcohol in Wt. per cent.	Gms. $MnSO_4$ per 100 Gms. Aq.	
	Ethyl Alc.	Propyl Alc.		Ethyl Alc.	Propyl Alc.
34	9.5	6	44	3.3	1.9
36	7.2	4.6	48	2.2	1.4
38	5.8	3.5	52	1.4	1.1
40	4.7	2.8			

100 cc. anhydrous hydrazine dissolve about 1 gm. $MnSO_4$ at room temp.

(Welsh and Broderson, 1915.)

Mn MANGANESE

1014

100 gms. sat. solution of Manganese Sulfate in Gycol contain 0.5 gm. MnSO_4 . (de Connick, 1905.)

SOLUBILITY OF ANHYDROUS MANGANESE SULFATE IN METHYL AND ETHYL ALCOHOLS.

(Gibson, Driscoll and Jones, 1929.)

Results for Methyl Alcohol

t°	Gms. MnSO_4 per 100 gms. CH_3OH	Solid Phase
15	0.190	MnSO_4
25	0.114	"
35	0.064	"
45	0.043	"
55	0.029	"

Results for Ethyl Alcohol

t°	Gms. MnSO_4 per 100 gms. $\text{C}_2\text{H}_5\text{OH}$	Solid Phase
15	0.012	MnSO_4
35	0.014	"
35	0.021	"

EQUILIBRIUM IN THE SYSTEM MANGANESE SULFATE, URETHAN AND WATER AT 25°.

(Palitsch, 1928, 1929.)

SO

Gm. Mols. per 1000 gms. H_2O		Solid Phase
MnSO_4	$\text{NH}_2\text{COOC}_2\text{H}_5$	
4.306	0.0	$\text{MnSO}_4 \cdot 7\text{H}_2\text{O}$
4.108	0.228	$\text{MnSO}_4 \cdot 7\text{H}_2\text{O} + \text{NH}_2\text{COOC}_2\text{H}_5$
0.007	52.16	Upper Liquid Layer
3.817	0.317	Lower Liquid Layer
0.0	53.07	$\text{NH}_2\text{COOC}_2\text{H}_5$

Fusion-point data for mixtures of $\text{MnSO}_4 + \text{K}_2\text{SO}_4$ and $\text{MnSO}_4 + \text{Na}_2\text{SO}_4$ are given by Calcaqui and Marotta, 1914.

MANGANESE Potassium VANADATE $\text{MnKV}_4\text{O}_{14} \cdot 8\text{H}_2\text{O}$.

100 gms. H_2O dissolve 1.7 gms. salt at 18°.

(Radan, 1889.)

MOLYBDENUM Mo

SOLUBILITY OF MOLYBDENUM IN MERCURY.

(Irvin and Russell, 1932.)

An amalgam containing approximately 0.2 gm. of Mo per 200 gms. of Hg was prepared by electrolysis and allowed to stand two days. This was filtered and the molybdenum in the filtrate found to be less than 0.00002 percent.

MOLYBDENUM TRIOXIDE (Molybdic acid dihydrate) $\text{MoO}_3 \cdot 2\text{H}_2\text{O}$.

SOLUBILITY IN WATER. (Rosenheim and Bertheim, 1903.)

t°.	Gms. MoO_3 per 1000 Gms.		t°.	Gms. MoO_3 per 1000 Gms.	
	Sat. Solution.	H_2O .		Sat. Solution.	H_2O .
18	1.065	1.066	59	10.117	11.258
23	1.822	1.856	60	10.760	12.057
30	2.570	2.638	66	14.730	17.274
40	4.541	4.761	70	17.048	20.550
48	5.980	6.360	74.4	17.290	20.904
50.2	6.431	6.873	75	17.300	20.920
54	7.283	7.855	79	17.400	21.064

When a solution of the dihydrate is held at 40–50°, considerable amounts of crystals, designated by the authors as α molybdic acid monohydrate, separate. They differ from the β molybdic acid monohydrate obtained by direct conversion of the dihydrate at 70°, in being better crystals and in yielding solutions which can be filtered.

SOLUBILITY OF α MOLYBDIC ACID MONOHYDRATE IN WATER.

(Rosenheim and Davidsohn, 1903.)

t°.	Gms. MoO_3 per 1000 Gms.		t°.	Gms. MoO_3 per 1000 Gms.	
	Sat. Solution.	H_2O .		Sat. Solution.	H_2O .
14.8	2.112	2.117	45	3.648	3.661
24.6	2.612	2.619	52	4.167	4.184
30.3	2.964	2.973	60	4.665	4.685
36.8	3.284	3.295	70	4.213	4.231
42	3.434	3.446	80	5.185	5.212

SOLUBILITY OF MOLYBDIC ACID DIHYDRATE IN AQ. AMMONIUM SALT SOLUTIONS. (R. and D., 1903.)

t°.	Solvent.	Gms. MoO_3 per 1000 Gms.	
		Sat. Solution.	Solvent.
29.6	10% $(\text{NH}_4)_2\text{SO}_4$	18.91	19.27
31.5	10% NH_4HSO_4	26.79	27.53
41.8	"	33.22	34.36
49.7	"	36.32	37.69

Fusion-point data for $\text{MoO}_3 + \text{Na}_2\text{MoO}_4$ are given by Groschuff (1908).

Experiments upon the formation of complexes in the system $\text{MoO} + \text{H}_2\text{O}$ are reported by Nowosselow, 1931.

NITROGEN N_2 .

SOLUBILITY IN WATER.

(Winkler — Ber. 24, 3606, '91; Braun — Z. physik. Chem. 33, 732, '00; Bohr and Bock — Wied. Ann. 44, 318, '91.)

t°	"Coefficient of Absorption" β .			"Solubility" B' .	g.
0	0.0235*	0.0239†	... ‡	0.0233*	0.00239*
5	0.0208	0.0215	0.0217	0.0206	0.00259
10	0.0186	0.0196	0.0200	0.0183	0.00230
15	0.0168	0.0179	0.0179	0.0165	0.00208
20	0.0154	0.0164	0.0162	0.0151	0.00189
25	0.0143	0.0150	0.0143	0.0139	0.00174
30	0.0134	0.0138	...	0.0128	0.00161
35	0.0125	0.0127	...	0.0118	0.00148
40	0.0118	0.0118	...	0.0110	0.00139
50	0.0109	0.0106	...	0.0096	0.00121
60	0.0102	0.0100	...	0.0082	0.00105
80	0.0096	...	...	0.0051	0.00069
100	0.0095	0.0100	...	0.0000	0.00000

β = Absorption Coefficient (Bunsen) i.e. the volume of gas (reduced to 0° and 760 mm Hg pressure) absorbed by 1 volume of the solvent when the pressure of the gas itself, minus the vapor tension of the solvent, amounts to 760 mm.

β' = Solubility i.e. the volume of gas (reduced to 0° and 760 mm) which is absorbed by one volume of the liquid when the barometer indicates 760 mm. pressure.

g = The weight of gas in grams which is taken up by 100 gms. of the pure solvent at the indicated temperature and total pressure (that is, the partial pressure of the gas plus the vapor pressure of the liquid at the absorption temperature) of 760 mm.

Single determinations of the solubility of nitrogen in water reported by Hülfer (1906-07), Bohr (1910), Müller (1912 13) and von Hammel (1915), are, on the average, about 2-3 units in the fourth place higher than the above figures of Winkler for the absorption coefficient β . Drucker and Moles (1910), give an extensive review of the literature and present results which, they state, are in very satisfactory agreement with previous determinations. A critical review of the literature of the solubility of nitrogen in water and in sea water is given by Coste (1917).

Data for the solubility of the nitrogen of air in water are given by Fox (1909a). The oxygen was removed from air and the solubility of the residual N + 1.185% argon was determined. After making correction for the argon, the following formula for the solubility of pure nitrogen in water was deduced.

$$1000 \times \text{coef. of abs. } \beta = 22.998 - 0.5298t + 0.009196t^2 - 0.00006779t^3.$$

Data for the solubility of nitrogen in water at pressures up to 10 atmospheres are given by Cassuto (1913). The solubility was found to increase at a somewhat slower rate than proportional to the pressure.

The solubility of N_2 in water at 25°, in terms of the Bunsen absorption coefficient (β above), was found by Orcutt and Geever, 1936, to be 0.0149. These authors made use of the Van Slyke-Neill, 1924, manometric apparatus which is based upon the principle of extracting the gas from the saturated solvent and measuring its pressure. By means of a special technique and method of calculating the correction for unextracted gas, this becomes a simple method of determining the solubility of any gas in any liquid without the aid of previously determined constants.

NITROGEN

SOLUBILITY OF NITROGEN IN WATER AT 25° AND AT PRESSURES UP
TO 200° ATMOSPHERES.

(Frollich, Tauch, Hogan and Peer, 1931.)

The determinations were made by shaking water and nitrogen at various pressures in a steel cylinder maintained at 25° and, after attainment of equilibrium, withdrawing a sample of the saturated solution over mercury, in one of three burets so designed that the volumes could be measured with the same degree of accuracy at any ratio of gas to liquid. The results are given only in the form of a diagram from which the following approximate values were read.

Pressure in Atmospheres	cc N ₂ (measured at 25° and 1 Atmosphere) per 1.0 cc H ₂ O	Pressure in Atmospheres	cc N ₂ (measured at 25° and 1 Atmosphere) per 1.0 cc H ₂ O
20	0.27	100	1.40
40	0.55	140	1.95
60	0.82	180	2.50
80	1.10	200	2.80

SOLUBILITY OF NITROGEN IN WATER AT 25°, 50°, 75°, AND 100° AND UNDER
PRESSURES UP TO 1000 ATMOSPHERES.

N

(Weibe, Gaddy and Heins Jr., 1932, 1933.)

The apparatus consisted of two steel cylinders respectively of 1000 cc and 300 cc capacity. They were filled with water to three fourths capacity and N₂ bubbled through at the desired temperature and pressure. Equilibrium was approached from pressures above and below that for the particular determination, and gas bubbled through at the final pressure for three hours and the saturated solutions allowed to stand 2-14 hours before samples were removed for analysis. The nitrogen was 99.9% pure, the impurities being argon and a trace of oxygen.

N ₂ Pressure in Atmospheres	cc N ₂ (reduced to 0° and 760mm) dissolved by 1.0 gm. H ₂ O at:			
	25°	50°	75°	100°
25	0.348	0.273	0.254	0.266
50	0.674	0.533	0.494	0.516
100	1.264	1.011	0.946	0.986
200	2.257	1.830	1.732	1.822
300	3.061	2.534	2.413	2.546
500	4.441	3.720	3.583	3.799
800	6.134	5.221	5.062	5.365
1000	7.15	6.123	5.934	6.250

The results show that it is not possible to predict with certainty the solubility of nitrogen in water at high pressures from determinations made at low pressures.

SOLUBILITY OF NITROGEN IN WATER AT 0° TO 170° AND AT PRESSURES FROM 100 TO 300 ATMOSPHERES.

(Goodman and Krase, 1931.)

The saturated solutions were prepared by stirring in a solubility pipet, by means of a magnetic stirrer, mixtures of water and nitrogen maintained at the desired pressures. The sample was removed through a needle valve at the bottom of the solubility vessel and separated into its gaseous and liquid constituents by means of a cooled trap.

t°	cc N ₂ (reduced to 0° and 760mm) dissolved by 1 gm. H ₂ O under pressure of:			
	100 Atmospheres	125 Atmospheres	200 Atmospheres	300 Atmospheres
0	1.46	1.76	3.19	3.62
25	1.07	1.44	2.76	3.25
50	1.003	1.24	2.49	2.99
80	0.934	1.15	2.27	2.86
100	0.954	1.17	2.25	2.91
144	1.025	1.30	2.68	3.45
169	1.08	1.52	3.29	3.83

SOLUBILITY OF NITROGEN IN WATER AT 50° TO 240° AND AT PRESSURES FROM 100 TO 300 ATMOSPHERES.

(Saddington and Krase, 1934.)

It is pointed out that a quantitative solution of the problem requires density measurements of both the liquid and vapor phase in these systems at high temperatures and pressures, as well as a knowledge of the compressibility coefficient of the liquid. The highly perfected apparatus permitted saturation of the water with N₂ at the desired temperatures and pressures and subsequent removal of samples of the liquid and gas phases for analysis.

Liquid Phase			Gas Phase			
t°	cc N ₂ (reduced to 0° and 760mm) to saturate 1.0 gm. H ₂ O	t°	Gms. H ₂ O per liter gas phase	Gms. per 1.0 gm. H ₂ O	Gms. per 1.0 gm. N ₂	Density of Gas Phase Gms. per liter
Results at 100 Atmospheres Pressure						
65	0.981	50	0.1236	0.00118	0.9988	—
80	0.777	80	0.3817	0.00403	0.9960	94.2
125	1.198	100	0.6474	0.00726	0.9927	88.0
180	1.644	150	2.710	0.0341	0.9659	76.8
210	1.817	190	5.880	0.0828	0.9172	68.5(210°)
240	2.027	230	13.300	0.1958	0.8042	67.7
Results at 200 Atmospheres Pressure						
50	1.806	50	0.1463	0.00085	0.9992	196.8
80	1.748	85	0.5116	0.00290	0.9971	176.7(80°)
100	1.825	150	2.960	0.0203	0.9797	145.8
150	2.172	190	7.550	0.0564	0.9436	132.6(200°)
200	3.287	225	14.840	0.1180	0.8820	122.0(240°)
240	4.378					
Results at 300 Atmospheres Pressure						
50	2.572	50	0.1975	0.00073	0.9993	273.1
70	2.425	75	0.4607	0.00362	0.9974	256.3(70°)
105	2.598	100	0.9126	0.00372	0.9963	237.2
135	3.128	115	1.450	0.00629	0.9937	225.0
165	3.905	145	3.240	0.0155	0.9835	212.1(140°)
230	6.062	165	5.320	0.0259	0.9741	198.3(170°)
		230	16.400	0.0933	0.9067	173.0(240°)

Calculated results for the compressibility factors of the gas phase are also given.

SOLUBILITY OF NITROGEN IN WATER AT 18° AND UNDER VERY HIGH PRESSURES.

(Basset and Dode, 1936.)

The apparatus permitted the gradual introduction of the liquid by bubbling until the desired pressure was attained. The gas was then allowed to remain in contact with the liquid at constant pressure until two succeeding determinations after a sufficient interval of time showed no further change. This period was approximately 80 hours. The difference between the present results and those of Wiebe and co-workers is considered probably due to small quantities of oil carried in during compression of the gas. The N_2 was of 99.7% purity and previously compressed to 1000 Kgs. per sq. cm. in four stages. Above about 3000 Kgs. pressure the solubility diminished.

Pressure in Kgs. per sq. cm.	cc N_2 (reduced to 0° and 760mm) per 1cc. H_2O	Pressure in Kgs. per sq. cm.	cc N_2 (reduced to 0° and 760mm) per 1cc. H_2O
500	4.3	3000	7.0
1000	6.1	4000	6.4
2000	6.9	4500	6.0

NITROGEN (Atmospheric) AIR

SOLUBILITY IN WATER.

(Winkler — Ber. 34, 1409, '01; see also Peterson and Sondern — Ber. 22, 1439, '89.)

t°.	B.	B'.	cc.* of atmospheric O and N per liter of:			
			Dist. H_2O (at 760 mm.).		Sea Water (at 760 mm.).	
			Oxygen.	Nitrogen.	Oxygen.	Nitrogen.
0	0.02881	0.02864	10.19	18.45	7.77	14.85
5	.02543	.02521	8.91	16.30	6.93	13.32
10	.02264	.02237	7.87	14.50	6.29	12.06
15	.02045	.02011	7.04	13.07	5.70	11.05
20	.01869	.01826	6.35	11.91	...	10.25
25	.01724	.01671	5.75	10.96	...	9.62
30	.01606	.01539	5.24	10.15		
40	.01418	.01315	4.48	8.67		
50	.01297	.01140	3.85	7.55		
60	.01216	.00978	3.28	6.50		
80	.01126	.00600	1.97	4.03		
100	.01105	.00000	0.00	0.00		

N

B = "Coefficient of Absorption," i.e., the amount of gas dissolved by the liquid when the pressure of the gas itself without the tension of the liquid amounts to 760 mm.

B' = "Solubility," i.e., the amount of gas, reduced to 0° and 760 mm., which is absorbed by one volume of the liquid when the barometer indicates 760 mm. pressure.

* Reduced to 0° and 760 mm.

SOLUBILITY OF AIR IN AQUEOUS SULPHURIC ACID AT 18° AND 760 MM.

(Tower — Z. anorg. Ch. 50, 382, '06.)

Wt. % H_2SO_4	98	90	80	70	60	50
Solubility Coef.	0.0173	0.0069	0.0069	0.0055	0.0059	0.0076

SOLUBILITY OF AIR IN ALCOHOL, ETC.

(Robinet, 1864.)

Solvent.	Vols. Air per 100 Vols. Solvent.	Solvent.	Vols. Air per 100 Vols. Solvent.
Alcohol (95 1%)	14.1	Oil of Lavender.	6.9
Petroleum	6.8	Oil of Turpentine	24.2
Benzene	14.0		

SOLUBILITY OF NITROGEN IN SEA WATER.
(Fox, 1909)

Before using the sample of sea water for the solubility determinations it was found necessary to add acid, otherwise the CO₂ could not be boiled out or the precipitation of neutral carbonates prevented. The very small amount of acid was titrated back, using phenolphthaleine as indicator.

The results are in terms of number of cc. of nitrogen (containing argon) absorbed by 1000 cc. of sea water from a free dry atmosphere of 760 mm. pressure. The calculated formula expressing the solubility is:

$$1000 a = 18.639 - 0.4304 t + 0.007453 t^2 - 0.0000549 t^3 \\ - C(0.2172 - 0.007187 t + 0.0000952 t^2).$$

Parts Chlorine per 1000.	t°=0°.	4°.	8°.	12°.	16°.	20°.	24°.	28°.
0	18.64	17.02	15.63	14.45	13.45	12.59	11.86	11.25
4	17.74	16.27	14.98	13.88	12.94	12.15	11.46	10.80
8	16.90	15.51	14.32	13.30	12.44	11.70	11.07	10.52
12	16.03	14.75	13.66	12.72	11.93	11.25	10.67	10.16
16	15.18	14	13	12.15	11.73	10.81	10.27	0.80
20	14.31	13.27	12.34	11.57	10.92	10.36	9.87	0.44

A recalculation of Fox's determinations to parts per million, with correction for vapor pressure, is published by Whipple and Whipple (1911).

SOLUBILITY OF NITROGEN IN AQUEOUS SOLUTIONS OF SULFURIC ACID

Results at 21° (Bohr, 1910)			Results at 20° (Christoff, 1906)	
Normality of Aq. H ₂ SO ₄ .	Absorption Coef. β (Bunsen).	Normality of Aq. H ₂ SO ₄ .	Per cent H ₂ SO ₄ .	Ostwald Solubility Expression β ₀ .
0	0.0156	24.8	0	0.01537
4.9	0.0091	29.6	35.82	0.008447
8.9	0.0072	34.3	61.62	0.006144
10.7	0.0066	35.8*	95.6	0.01572
20.3	0.0049			

* = about 96%.

For definitions of Absorption Coef. (Bunsen) and Solubility Expression (Ostwald), see p. 1136.

SOLUBILITY OF NITROGEN IN AQUEOUS SALT SOLUTIONS.
(Braun)

Coefficient of Absorption of N in Barium Chloride Solutions of:					
t°.	13.83 Per cent	11.92 Per cent.	6.99 Per cent.	3.87 Per cent.	3.13 Per cent.
5	0.0127	0.0137	0.0160	0.0180	0.0183
10	0.0117	0.0125	0.0147	0.0166	0.0168
15	0.0104	0.0114	0.0132	0.0148	0.0150
20	0.0092	0.0098	0.0118	0.0132	0.0135
25	0.0078	0.0086	0.0104	0.0114	0.0110

Coefficient of Absorption of N in Sodium Chloride Solutions of:					
t°.	11.73 Per cent.	8.14 Per cent.	6.1 Per cent.	3.12 Per cent.	0.67 Per cent.
5	0.0102	0.0127	0.0148	0.0179	0.0200
10	0.0093	0.0113	0.0126	0.0164	0.0185
15	0.0081	0.0101	0.0113	0.0147	0.0164
20	0.0066	0.0087	0.0098	0.0131	0.0148
25	0.0047	0.0075	0.0083	0.0113	0.0130

SOLUBILITY OF NITROGEN IN ALCOHOL.
(Bunsen.)

t°.	0°.	5°.	10°.	15°.	20°.	24°.
Vols. N* dissolved by 1 Vol. Alcohol.	0.1263	0.1244	0.1228	0.1214	0.1204	0.1198

* At 0° and 760 mm.

SOLUBILITY OF ATMOSPHERIC NITROGEN AND OXYGEN IN AQUEOUS
AMMONIUM CHLORIDE SOLUTIONS. (Coste and Andrews, 1924.)

In attempting to explain the unexpected results of Mac Arthur (*J. Phys. Chem.*, 20, 495, 1916) upon the solubility of atmospheric air in ammonium chloride solutions, the authors found that the trouble was with the method of analysis. New determinations were made as follows.

Solutions of ammonium chloride in distilled water were subjected to a stream of air for some hours and then examined (1) by the Winkler manganous process and (2) by the Winkler gasometric process (*Z. anal. Chem.*, 40, 523, 1901) in which the oxygen and nitrogen dissolved in the water are evolved by a current of CO_2 generated in the water from calcite by means of hydrochloric acid. The following results were obtained:

Molar conc. of the NH_4Cl solution.	t° of saturation with air.	Dissolved gases in cc. per liter		
		Gasometric process		Manganous process Oxygen.
		Nitrogen + Argon.	Oxygen.	
0.5	20	10.65	5.48	5.46 (18 hrs.)
1.0	20	10.29	5.08	
1.0	19	10.15	5.70	2.6 (20 hrs.)
2.0	22	7.79	3.93	1.6 (over night)

Although highest accuracy is not claimed for the results they show, that the solubility of air in aqueous ammonium chloride is very different from that given by Mac Arthur. They also demonstrate the inapplicability of the manganous process in presence of large amounts of ammonium salts.

N

Extensive data upon the rate of solution of atmospheric nitrogen and oxygen in water are given in a series of papers by Adeney and Becker, 1916-1920, 1919, 1920 and 1921. One of the methods of experimenting consisted in inclosing a large bubble of air, of known volume, in a narrow tube containing deaerated water, and allowing the bubble to pass up through the water repeatedly until saturation was reached. From the figures given it is possible to calculate the rate of solution for any condition of area exposed, depth, or degree of saturation.

A critical examination of the available data upon the Solubility of Nitrogen in pure water and in sea water has been made by Coste, 1927. It is concluded that "When proper allowances have been made for the effect of argon in the solubility of atmospheric nitrogen, considerable uncertainty exists as to the absorption coefficients of both this mixed gas and pure nitrogen in distilled water. A similar uncertainty exists in the case of sea water."

SOLUBILITY OF NITROGEN IN MIXTURES OF ETHYL ALCOHOL AND WATER
AT 25° .
(Just, 1901.)

Results in terms of the Ostwald solubility expression, see p. 1136

Vol. % H_2O in Mixture.	Vol. % Alcohol in Mixture.	Dissolved N (l_{25}).
100	0	0.01634
80	20	0.01536
67	33	0.01719
0	100 (99.8% Alcohol)	0.1432

SOLUBILITY OF NITROGEN IN AQUEOUS PROPIONIC ACID AND UREA SOLUTIONS.

(Braun.)

t°.	Coefficient of Absorption of N in C ₂ H ₅ COOH Solutions of:				
	11.22 per cent.	9.54 per cent.	6.07 per cent.	4.08 per cent.	3.82 per cent.
5	0.0195	0.0204	0.0208	0.0210	0.0209
10	0.0178	0.0182	0.0186	0.0192	0.0191
15	0.0159	0.0163	0.0164	0.0169	0.0167
20	0.0146	0.0147	0.0148	0.0154	0.0155
25	0.0130	0.0134	0.0134	0.0137	0.0137

t°.	Coefficient of Absorption of N in CO(NH ₂) ₂ Solutions of:					
	15.65 per cent.	11.9 per cent.	9.42 per cent.	6.90 per cent.	5.15 per cent.	2.28 per cent.
5	0.0175	0.0179	0.0190	0.0198	0.0197	0.0199
10	0.0162	0.0167	0.0176	0.0183	0.0182	0.0184
15	0.0150	0.0149	0.0158	0.0165	0.0165	0.0171
20	0.0140	0.0139	0.0146	0.0151	0.0151	0.0155
25	0.0130	0.0130	0.0133	0.0137	0.0135	0.0139

SOLUBILITY OF NITROGEN IN AQUEOUS SOLUTIONS OF CHLORAL HYDRATE AT 15°.

Results by Müller, C (1912-13.)

Results by von Hammel (1915).

Gms. CCl ₃ CH(OH) ₂ per 100 Gms. Aq. Sol.	d ₂₀ of Aq. Sol.	Absorp. Coef. β at 15°.	Gms. CCl ₃ CH(OH) ₂ per 100 Gms. Aq. Sol.	Abs. Coef. β at 15°.	Solubility l ₂₅ (Ostwald).
0	1	0.0170	0	0.0170	0.01796
15.8	1.0738	0.0158	15	0.0152	0.0160
28.2	1.1422	0.01422	26.1	0.0141	0.0149
37.25	1.1946	0.01300	37.6	0.0123	0.0130
47	1.2535	0.01275	48.9	0.0115	0.0121
56.52	1.3225	0.01245	61.3	0.0114	0.0120
71.5	1.441	0.01420	70.9	0.0131	0.0138
78.8	1.503	0.01492	79.1	0.0156	0.0165

SOLUBILITY OF NITROGEN IN AQUEOUS SOLUTIONS OF GLYCEROL.

Results of Müller, C.

Results of von Hammel

Results of Drucker

(1912-13).

(1915).

and Moles (1910).

Gms. (CH ₂ OH) ₂ CHOH per 100 Gms. Aq. Sol.	d ₁₈ of Aq. Sol.	Abs. Coef. β at 15°.	Gms. (CH ₂ OH) ₂ CHOH per 100 Gms. Aq. Sol.	Abs. Coef. β at 15°.	Gms. (CH ₂ OH) ₂ CHOH per 100 Gms. Aq. Sol.	d ₂₅ of Aq. Sol.	Solubility l ₂₅ (Ostwald).
25	1.061	0.01266	15.7	0.01400	0	0	0.0156
42.2	1.108	0.00976	29.9	0.01087	16	1.0312	0.0103
51.5	1.133	0.00759	46.6	0.00840	20.7	1.0744	0.0067
58	1.151	0.00703	57.6	0.00608	48.9	1.1263	0.0052
80.25	1.212	0.00530	67.1	0.00635	74.5	1.1031	0.0025
90	1.240	0.00583	77	0.00527	84.1	1.2213	0.0024
95	1.249	0.00716	88.5	0.00536			
			99.25	0.00524			

Solubility of N₂ in pure isobutyric acid of d₂₅ = 0.9481, l₂₅ (Ostwald) = 0.1651. (Drucker and Moles, 1910.)

Solubility of N₂ in aq. 37.5% isobutyric acid of d₂₅ = 0.9985, l₂₅ (Ostwald) = 0.0396. (Drucker and Moles, 1910.)

Solubility of N₂ in aq. 37.5% isobutyric acid of d₂₅ = 0.9985, l₂₉ (Ostwald) = 0.0384. (Drucker and Moles, 1910.)

SOLUBILITY OF NITROGEN IN AQUEOUS SOLUTIONS OF SEVERAL COMPOUNDS.

(Hünner, 1906-07.)

Aq. Solution of:	Conc. of Aq. Solution.		t°.	Abs. Coef. β .
	Normality.	Gms. per Liter.		
Glucose	1	180	20.18	0.01215
"	0.5	90	20.21	0.01380
"	0.25	45	20.2	0.01480
Alanine (α Aminopropionic Acid)	1	80	20.10	0.01213
Glyocol (Aminoacetic Acid)	1	75	20.16	0.01212
Aribinose	1	150	20.21	0.01203
Levulose	1	180	20.25	0.01221
Erythritol	1	122	20.25	0.01371
Urea	1	60	20.18	0.01477
Acetamide	1	59	20.22	0.01475

SOLUBILITY OF NITROGEN IN AQUEOUS SOLUTIONS OF CANE SUGAR AT 15°.

(Müller, C., 1912-13.)

Gms. $C_{12}H_{22}O_{11}$ per 100 Gms. Aq. Solution.	d_{16} of Aq. Sol.	Abs. Coef. β at 15°.	Gms. $C_{12}H_{22}O_{11}$ per 100 Gms. Aq. Solution.	d_{16} of Aq. Sol.	Abs. Coef. β at 15°.
11.38	1.050	0.01480	30.12	1.120	0.01090
20	1.082	0.01280	47.80	1.220	0.00785
29.93	1.128	0.01053	48.57	1.223	0.00700

Data for the solubility of nitrogen in defibrinated ox-blood and ox serum under pressures varying 760-1400 mm. Hg are given by Findlay and Creighton (1910-11).

Data for the solubility of nitrogen in liquid oxygen are given by Erdman and Bedford (1904) and Stock (1904.)

SOLUBILITY OF NITROGEN IN SERUM, PLASMA AND HAEMOGLOBIN SOLUTIONS.

Solvent.	t°.	Cc. N_2 per 100 cc. solvent.	Authority
Water.....	20	1.561	(Stoddard, 1927.)
Plasma proteins, series 1....	20	1.5168	"
" " 2....	20	1.5156	"
Haemoglobin solutions.....	20	1.613	"
Blood Plasma.....	15	1.7	(O'Brien and Parker, 1922.)
"	38	1.2	" quoted from Bohr, 1905.)
Whole Blood.....	15	1.6	"
"	38	1.1	"
Blood Corpuscles.....	15	1.4	"
"	38	1.0	"

100 cc. rubber dissolve 3.5 cc. nitrogen (reduced to 0° and 760 mm.) at 21°. The dissolved gas was pumped out with a Töpler pump and measured over mercury. (Venable and Fuwa, 1922.)

SOLUBILITY OF NITROGEN IN PLASMA, BLOOD ETC. AT 38°.

(Van Slyke, Dillon and Margaria; 1934; Sendroy, Dillon and Van Slyke, 1934.)

Solvent	cc N_2 * per 1 cc solvent	cc N_2 * per 1 gm. H_2O of solvent
Water	0.01272	0.01281
0.155 Mol. Aq. NaCl	0.01220	0.01238
Plasma	0.117	0.0124
Cells	0.0146	0.0200
Blood (20 Vol. % O_2 cap.)	0.0130	0.0158
Haemoglobin	0.017 †	—

* reduced to 0° and 760mm; † is cc N_2 dissolved by 1 gm. dissolved Haemoglobin when the gas tension is 760mm.

SOLUBILITY OF NITROGEN IN WATER AND IN WHOLE BLOOD AT 38°
AND UNDER PRESSURES UP TO 6 ATMOSPHERES.

(Hawkins, and Shilling, 1936.)

Calves and dogs blood oxalated to 0.02% was either used immediately or after being kept at 0° until next day. The Van Slyke and Neill (1920) manometric apparatus was used and the determinations made upon 5cc samples.

Results for Water

N ₂ Pressure in Hm Hg	N ₂ content of H ₂ O Vol. percent	Abs. Coef. α, cc N ₂ per cc solution
714	1.21	0.01281
1486	2.55	0.01300
2980	4.97	0.01261
4592	7.67	0.01270

Results for Blood

N ₂ Pressure in Hm Hg	N ₂ content of Blood Vol. percent	Abs. Coef. α, cc N ₂ per cc solution	Abs. Coef. α, cc N ₂ per gm. H ₂ O in Blood
715	1.31	0.0138	0.0171
1481	2.68	0.0136	0.0169
3071	5.52	0.0136	0.0169
4508	8.04	0.0134	0.0166

α = the Bunsen Absorption Coefficient is the cc of N₂ (reduced to 0° and 760 mm) which are dissolved by 1cc of the saturated solution at a pressure of 760mm Hg.

9 samples of blood were used varying in O₂ capacity from 15.70 to 20.14 Vol. percent. The above results are for the sample having 20.14 O₂ capacity. The abs. coef. varied from 0.0138 to 0.0148 for dogs' blood and 0.0135 to 0.0140 for ox blood.

The Solubility of Nitrogen in Water and in aqueous suspensions of blood lipoids was determined by Grollman, 1929, with results showing that the lipoids increase the solubility of the nitrogen.

Determinations of the Solubility of Nitrogen in Azobacter Cells are given by Lineweaver, 1938.

SOLUBILITY OF NITROGEN IN METHYL ALCOHOL SOLUTIONS OF POTASSIUM
IODIDE AND OF UREA.

(Levi, 1901.)

Solvent.		Solubility of N (in terms of the Ostwald Solubility Expression I).					
Gms. KI or of Urea per 100 Gms. CH ₃ OH Solution.		At 5°.		At 15°.		At 25°.	
		d ₅ of Solvent.	I ₅	d ₁₅ of Solvent.	I ₁₅	d ₂₅ of Solvent.	I ₂₅
0	(=pure CH ₃ OH)	0.8080	0.2154	0.7980	0.1923	0.7937	0.1649
2.152	KI	0.8171	0.2028	0.8070	0.1802	0.8019	0.1524
3.053	"	0.8249	0.1906	0.8015	0.1756	0.8101	0.1466
10.939	"	0.8930	0.1676	0.8841	0.1464	0.8801	0.1258
2.738	Urea	0.8148	0.2030	0.8050	0.1823	0.7997	0.1561
4.841	"	0.8231	0.1951	0.8122	0.1750	0.8080	0.1491
7.377	"	0.8350	0.1878	0.8241	0.1690	0.8193	0.1444

SOLUBILITY OF NITROGEN IN ETHYL ETHER.

(Christoff, 1912.)

Results in terms of the Ostwald expression I, see p. 1136, I₅ = 0.2580, I₁₀ = 0.2561.

SOLUBILITY OF NITROGEN IN SEVERAL SOLVENTS AT 20° AND 25°.
(Just.)

Solvent.	l_{20} .	l_{25} .	Solvent.	l_{20} .	l_{25} .
Water	0.01634	0.01705	Toluene	0.1235	0.1186
Aniline	0.03074	0.02092	Chloroform	0.1348	0.1282
Carbon Disulfide	0.05860	0.05200	Methyl Alcohol	0.1415	0.1348
Nitro Benzene	0.06255	0.06082	Ethyl Alcohol (99.8%)	0.1432	0.1400
Benzene	0.1159	0.1114	Acetone	0.1460	0.1383
Acetic Acid	0.1190	0.1172	Amyl Acetate	0.1542	0.1512
Styrene	0.1217	0.1185	Ethyl Acetate	0.1727	0.1678
Methyl Alcohol	0.1225	0.1208	Isobutyl Acetate	0.1734	0.1701

SOLUBILITY OF NITROGEN IN SEVERAL SOLVENTS AT DIFFERENT TEMPERATURES.
(Horvutl, 1931; Horvutl, 1932.)

Results for:

Carbon Tetrachloride		Ethyl Ether		Benzene		N
t°	l	t°	l	t°	l	
-19.7	0.1256	-77.7	0.2055	7.1	0.1061	
0	0.1403	-60.6	0.2144	20	0.1162	
20	0.1572	-41.1	0.2286	25	0.120	
25	0.162	-20.5	0.2452	40	0.1355	
40.1	0.1754	0	0.2672	60	0.1575	
60.1	0.1953	20	0.2870			
		25	0.293			
Acetone		Methyl Acetate		Chlorobenzene		
t°	l	t°	l	t°	l	
-78.1	0.0967	-78.7	0.0900	-39.7	0.0695	
-60.3	0.1081	-60.1	0.1032	-19.7	0.0778	
-40.75	0.1211	-40.6	0.1190	0.0	0.0881	
-20.2	0.1376	-20.3	0.1353	20.0	0.0994	
0	0.1553	0.0	0.1551	25	0.102	
20	0.1747	20	0.1748	40.1	0.1116	
25	0.179	25	0.179	60.05	0.1259	
40.1	0.1946	40.1	0.1957	80.3	0.1399	

l = Ostwald Solubility Expression which is the ratio of the volume (v) of gas absorbed at any pressure and temperature, to the volume (V) of the absorbing liquid, that is $l = \frac{v}{V}$. The solubility l is therefore the volume of gas dissolved by unit volume of the solvent at the temperature of the experiment.

NITROGEN

SOLUBILITY OF NITROGEN IN SEVERAL SOLVENTS AT 25° AND UNDER PRESSURES UP TO 180 ATMOSPHERES.

(Frollich, Touch, Hogan and Peer, 1931.)

The determinations were made by shaking the solvents and nitrogen at various pressures in a steel cylinder maintained at 25° and, after attainment of equilibrium, withdrawing a sample of the saturated solution under mercury in one of three burets, so designed that the volumes could be measured with the same degree of accuracy at any ratio of gas to liquid. The results are given only in the form of a diagram from which the following approximate values were read.

Pressure in Atmospheres	cc N ₂ (measured at 25° and 1 atmosphere) per 1.0 cc liquid in:					
	Butane CH ₃ (CH ₂) ₂ CH ₃	Carbon Tetra Chloride, CCl ₄	Iso Propanol CH ₃ CHOHCH ₃	Ethanol C ₂ H ₅ OH	Heavy Naphtha	Gas oil
20	10.6	3.0	2.5	2.0	2.1	2.0
40	22.0	6.25	5.0	4.25	4.5	4.5
60	32.8	9.3	7.5	6.25	6.3	6.3
80	44.0	12.5	10.0	8.1	8.1	8.1
100	55.0	15.6	12.5	10.2	10.0	9.8
120	62.5	18.75	15.0	12.0	11.5	11.2
140	76.0	22.0	17.5	13.75	13.0	12.75
160	88.0	—	20.0	15.5	—	—
180	99.0	—	—	—	—	—

The heavy naphtha had a sp. gr. of 0.8003 and vapor pressure of 80mm at 25°. The gas oil had a sp. gr. of 0.8319 and vapor pressure of 2mm at 25°.

Data for the Solubility of Nitrogen in Normal Heptane at 25°-115° and under 100.9 atmospheres pressure are given by Boomer, Johnson and Piercey, 1938.

SOLUBILITY OF NITROGEN IN PETROLEUM. COEFFICIENT OF ABSORPTION AT 10° = 0.135, AT 20° = 0.117.

(Gniewas and Wallisz, 1887.)

The Coefficient of Absorption of Nitrogen in American Mineral Oil (d = 0.868 at 27°; viscosity (saybolt) = 285 at 100° F.; congealing point = 37°) was found by Kubie, 1927 (using the Van Slyke and Neil, 1924, apparatus) to be

0.071 ccN₂ (reduced to 0° and 760mm) per 1.0cc oil at 22°.

SOLUBILITY OF NITROGEN IN LIQUID AMMONIA AT 25° AND FROM
25 TO 1000 ATMOSPHERES PRESSURE.

(Wiebe and Tremearne, 1934.)

Liquid ammonia and Nitrogen were shaken together at given pressures in a steel cylinder of 1400cc. capacity. The sample removed for analysis was received in a vessel immersed in liquid air, and subsequently analyzed by appropriate methods. The vapor pressure of liquid ammonia at 25° is 9.8955 atmospheres.

Total Pressure Atmospheres	cc N ₂ (at 0° and 760mm) dissolved per 1.0 gm. NH ₃	Total Pressure in Atmospheres	cc N ₂ (at 0° and 760mm) dissolved per 1.0 gm. NH ₃
25	2.22	400	37.02
50	5.73	600	45.43
100	12.04	800	51.10
200	22.48	1000	54.83

Results for the system Nitrogen + Hydrogen + Ammonia (Gas) + Ammonia (liquid) at temperatures from -22.5 to +18.7° and pressures from 50 to 1000 atmospheres are given by Larson and Black, 1925. A discussion of these and similar results for other systems, in the concept that solubility effect is a change in activity of one component resulting from the presence of the other component, is given by Cupples, 1929.

SOLUBILITY OF NITROGEN IN LIQUID SULFUR DIOXIDE.

(Donte and Ferguson, 1939.)

The determinations were made in an apparatus which permitted measurements in the static system and in a circulating system. In addition the authors have calculated extrapolated values which are considered to be probably as reliable as the experimental determinations.

t°	cc N ₂ (at 0° and 760mm) dissolved in 1.0 gm. of the liquid when the partial pressure of the gas is 1 atmosphere		
	Static Experiments	Circulation Experiments	Calculated values
-60	2.86	2.15	—
-50	6.35	4.41	—
-40	12.3	7.88	—
-30	27.2	—	—
-20	56.6	26.7	47
-10	—	—	87
0	—	—	150
+10	—	—	260
20	—	—	435
30	—	—	600

SOLUBILITY OF NITROGEN IN METALS.

Results for Cobalt (Sieverts and Hagen, 1934.)
 " " Ferrum (Jurisch, 1912; Martin, 1929; Sieverts, 1911;
 " " Molybdenum (Martin, 1929.) 1918.)
 " " Wolfram (Tungsten) (Martin, 1929.)

HYDROXYLAMINE $\text{NH}_2(\text{OH})$.**HYDROXYLAMINE HYDROCHLORIDE** $\text{NH}_2(\text{OH})\cdot\text{HCl}$.SOLUBILITY OF EACH IN SEVERAL SOLVENTS.
(de Bruyn, 1892.)

Solvent.	t°.	Gms. NH_2OH per 100 Gms. Solution.	t°.	Gms. $\text{NH}_2(\text{OH})\cdot\text{HCl}$ per 100 Gms. Solvent.
Methyl Alcohol (abs.)	5	35	19.75	16.4
Ethyl Alcohol (abs.)	15	15	19.75	4.43
Ether (dry)	(b. pt.)	1.2	...	...
Ethyl Acetate	(b. pt.)	1.6	...	...

For densities of $\text{NH}_2(\text{OH})\cdot\text{HCl}$ solutions, see Schiff and Monsacchi, 1896.**PhthalylHYDROXYLAMINE** $\text{C}_6\text{H}_4 < \begin{smallmatrix} \text{CO} \\ \text{C:NOH} \end{smallmatrix} > \text{O}$.One liter benzene dissolves 0.33 gm. of the A form of melting point 220° - 226° .
(Sidgwick, 1915.)**HYDRAZINE** $\text{NH}_2\cdot\text{NH}_2$.

Fusion-point data are given for:

$\text{NH}_2\cdot\text{NH}_2 + \text{C}_2\text{H}_5\text{OH}$	(Epstein, 1939.)
" + $\text{CO}(\text{NH}_2)_2$ (Urea)	(Semisine, 1939.)
" + $\text{N}_2\text{H}_5\text{N}_3$	(Dresser, Browne, and Mason, 1933.)
" + $\text{N}_2\text{H}_5\text{N}_3 + \text{NH}_3$	(Howard, Jr., and Browne, 1934.)
$\text{N}_2\text{H}_5\text{N}_3 + \text{NH}_3$	" "

HYDRAZINE $\text{NH}_2\cdot\text{NH}_2$.DISTRIBUTION OF HYDRAZINE BETWEEN WATER AND BENZENE.
(Georgievics, 1915.)

Gms. $\text{NH}_2\cdot\text{NH}_2$ per:		Gms. $\text{NH}_2\cdot\text{NH}_2$ per:	
25 cc. H_2O Layer.	75 cc. C_6H_6 Layer.	25 cc. H_2O Layer.	75 cc. C_6H_6 Layer.
0.4137	0.027	1.7601	0.0626
0.6676	0.0335	2.3336	0.1101
1.0862	0.0355	4.75	0.137

HYDRAZINE PerCHLORATE $\text{N}_2\text{H}_4(\text{HClO}_4)_2 \cdot 3\text{H}_2\text{O}$.

SOLUBILITY IN WATER. (Carlson, 1910.)

t°.	Sp. Gr. Sat. Sol.	Gms. $\text{N}_2\text{H}_4(\text{HClO}_4)_2$ per 100 cc. Sat. Sol.
18	1.264	41.72
35	1.391	66.9

HYDRAZINE MonoNITRATE $\text{N}_2\text{H}_4\cdot\text{HNO}_3$.

SOLUBILITY IN WATER. (Sommer, 1914.)

t°.	Gms. $\text{N}_2\text{H}_4\cdot\text{HNO}_3$ per 100 Gms.		t°.	Gms. $\text{N}_2\text{H}_4\cdot\text{HNO}_3$ per 100 Gms.	
	Sat. Sol.	Water.		Sat. Sol.	Water.
10	63.63	174.9	40.02	85.86	607.2
15	68.47	217.2	45.02	88.06	737.6
20.01	72.70	266.3	50.01	91.18	1034
25.01	76.61	327.5	55.01	93.58	1458
30.01	80.09	402.2	60.02	95.51	2127
35.01	83.06	490.3			

HYDRAZINE PICRATE $N_2H_5OC_6H_2(NO_2)_3 \cdot \frac{1}{2}H_2O$.

SOLUBILITY OF HYDRAZINE PICRATE IN AQUEOUS SOLUTIONS OF SALTS AT 20°.
(Gilbert, 1929.)

Gm. Mols. Salts per liter aqueous solvent	Gm. Mols. $N_2H_5OC_6H_2(NO_2)_3$ per liter sat. sol.
Water alone	0.01396
0.020 NH_4Cl	0.01499
0.050 "	0.01586
0.080 "	0.01655
0.100 "	0.01690
0.090 " + 0.01 NH_4 Pic.	0.01313
0.080 " + 0.02 "	0.01188
0.070 " + 0.03 "	0.01108
0.104 " + 0.005 "	0.01497
0.102 " + 0.003 "	0.01566
0.100 " + 0.012 "	0.01360
0.100 " + 0.01745 "	0.01387
0.05 " + 0.01 "	0.01209
0.100 " + 0.01 "	0.01388
0.100 " + 0.005 "	0.01495
0.100 $NaNO_3$	0.01611
0.100 $NaPic$.	0.04322
0.090 NH_4Cl + 0.009793 N_2H_5Cl	0.01231
0.080 " + 0.01950 "	0.00993
0.070 " + 0.02952 "	0.00690
0.100 $NaPic$.	0.00314 (15°)
0.050 " + 0.05 $NaCl$	0.00414 (15°)
0.100 $NaCl$	0.01176 (15°)

H₂

NH_4Pic . (Picrate) $NH_4OC_6H_2(NO_2)_3$; $NaPic$ (Picrate), $NaOC_6H_2(NO_2)_3$.

The author also gives results for the Solubility of Croceo Dinitro Tetrammine Cobalti Picrate and Flavo Tetra Rhodano Diammine Chromate in aqueous solutions of $NaCl$ and Na Picrate. He also gives results for Tri ethyl amine Picrate and Tri propyl amine picrate in these salt solutions.

SOLUBILITY OF HYDRAZINE PICRATE IN AQUEOUS SOLUTIONS
OF ETHYL ALCOHOL AT 20°.
(Gilbert and Huffman, 1932.)

Wt. Percent C_2H_5OH in Aq. Solvent	Gm. Mols. $N_2H_5OC_6H_2(NO_2)_3$ per liter sat. solution	Wt. Percent C_2H_5OH in Aq. Solvent	Gm. Mols. $N_2H_5OC_6H_2(NO_2)_3$ per liter sat. solution
0.0 (= H_2O)	0.01396	60	0.01991
10	0.01160	69.4	0.01616
15	0.01076	79.7	0.01176
25	0.01113	96.0	0.00525
34.5	0.01448	99.8 (Vol. Percent)	0.00694
51	0.01890		

Data for the Solubility of Hydrazine Picrate at 15° in dilute aqueous solutions of $NaCl$ + HCl in presence of acetone were determined by Gilbert 1929(a), in connection with studies of the hydrolysis of hydrazine by acetone.

HYDRAZINE Tri Nitro Methyl CRESYLATE, $N_2H_5OC_6H(NO_2)_3CH_3.H_2O$ SOLUBILITY OF TRI NITRO METHYL CRESYLATE IN WATER AND IN
AQUEOUS SOLUTIONS OF ETHYL ALCOHOL.

(Gilbert and Huffman, 1932.)

Results for Water

t° Gm. Mols. $N_2H_5OC_6H(NO_2)_3CH_3$ Per liter sat. sol.

15 0.08473
20 0.1158
25 0.1506
30 0.2053

Wt. Percent C_2H_5OH in Aq. Solvent

5.0
15
25
34.5
50

Results for Aq. Alcohol at 20°

Gm. Mols. Cresylate per liter sat. sol.

0.1015
0.08996
0.1089
0.1509
0.2170

Wt. Percent C_2H_5OH in Aq. Solvent

60.
69.4
79.70
96.0
99.8 (Vol%)

Gm. Mols. Cresylate per liter sat. sol.

0.2297
0.2189
0.1843
0.0710
0.0517

HYDRAZINE SULFATES $(N_2H_5)_2SO_4$ (I), $N_2H_6SO_4$ (II).

SOLUBILITY OF THE TWO HYDRAZINE SULFATES IN WATER. (Sommer and Weise, 1916.)

Results for $(N_2H_5)_2SO_4$.

Gms. $(N_2H_5)_2SO_4$ per 100 gms. sat. sol. Mols. $(N_2H_5)_2SO_4$ per liter.

t° 25... 66.91 12.48
35... 71.28 15.32
45... 78.54 22.59
50... 82.33 28.76
55... 83.40 31.01
60... 84.72 34.22

Solid Phase.
 $(N_2H_5)_2SO_4.H_2O$
"
"
"
 $(N_2H_5)_2SO_4$
"

Results for $N_2H_6SO_4$.

Gms. $N_2H_6SO_4$ per 100 gms. sat. sol. Mols. $N_2H_6SO_4$ per liter.

t° 20... 2.794 0.220
25... 3.302 0.260
30... 3.746 0.299
40... 3.987 0.404
50... 6.538 0.538
60... 8.322 0.698
70... 10.465 0.902
80... 12.580 1.107

Solid Phase.
 $N_2H_6SO_4$
"
"
"
"
"
"
"

SOLUBILITY OF BIVALENT HYDRAZINE SULFATE (II) IN AQUEOUS SOLUTIONS
OF ACIDS AT 25° . (Sommer and Weise, 1916.)In aq. H_2SO_4 .

Gms. H_2SO_4 per liter. Gms. $N_2H_6SO_4$ per 100 gms. sat. sol.

0.4897 3.143
4.887 2.680
26.59 1.541
49.00 1.026
116.18 0.518
144.18 0.4318

In aq. HCl .

Gms. HCl per liter. Gms. $N_2H_6SO_4$ per 100 gms. sat. sol.

0.00 3.302
0.3645 3.156
3.645 2.876
18.25 2.652
36.45 2.639
66.08 2.615

In aq. CH_3COOH

Gms. CH_3COOH per liter. Gms. $N_2H_6SO_4$ per 100 gms. sat. sol.

0.5157 3.198
6.8963 3.147
33.306 2.903
63.00 2.737
117.38 2.323

AMMONIA NH_3 .

SOLUBILITY OF AMMONIA IN WATER.

(Roscoe and Dittmar—Liebig's Annalen, 112, 334, '59; Raoult—Ann. chim. [5] 1, 262, 74; Mallet—Am. Ch. J. 19, 807, '97.)

t°.	At 760 mm. Pressure.		t°.	At 760 mm. Pressure.	
	G. NH_3 per 100 g. H_2O .	Vol. NH_3 per 1 g. H_2O .		G. NH_3 per 100 g. H_2O .	Vol. NH_3 per 1 g. H_2O .
-40	294.6	...	20	52.6	710
-30	278.1	...	25	46.0	635
-20	176.8	...	30	40.3	595 (28°)
-10	111.5	...	35	35.5	...
0	87.5	1299	40	30.7	...
5	77.5	1019	45	27.0	...
10	67.9	910	50	22.9	...
15	60.0	802	56	18.5	...

SOLUBILITY OF AMMONIA IN WATER DETERMINED BY METHOD OF LOWERING OF FREEZING-POINT.

(Rupert, 1910.)

t°	Gms. NH_3 per 100 Gms. Sol.	Solid Phase.	t°	Gms. NH_3 per 100 Gms. Sol.	Solid Phase.
0	0	Ice	-80.6	52	$\text{NH}_4\text{H}_2\text{O}$
-2	2	"	-82.8	54	"
-4.6	4	"	-85.8	56	"
-7.6	6	"	-87	Eutec. 56.5	$\text{NH}_4\text{H}_2\text{O} + 2\text{NH}_4\text{H}_2\text{O}$
-10.6	8	"	-84.8	58	$2\text{NH}_4\text{H}_2\text{O}$
-13.9	10	"	-82.2	60	"
-17.6	12	"	-80.4	62	"
-21.4	14	"	-79.2	64	"
-25.8	16	"	-79.8 m. pt.	66	"
-31.3	18	"	-79.2	68	"
-37	20	"	-80.3	70	"
-43.6	22	"	-82.1	72	"
-50.7	24	"	-84.5	74	"
-60.3	26	"	-87.4	76	"
-72.2	28	"	-90.4	78	"
-87.2	30	"	-93.6	80	"
-102.3	32	"	-94	Eutec. 80.3	$2\text{NH}_4\text{H}_2\text{O} + \text{NH}_4\text{H}_2\text{O}$
-116.7	34	"	-91.7	82	$\text{NH}_4\text{H}_2\text{O}$
-120	Eutec. 34.5	Ice + $\text{NH}_4\text{H}_2\text{O}$	-89.4	84	"
-103.8	36	$\text{NH}_4\text{H}_2\text{O}$	-87.4	86	"
-92.9	38	"	-85.6	88	"
-86.7	40	"	-84.1	90	"
-83.5	42	"	-82.7	92	"
-81.4	44	"	-81.5	94	"
-80	46	"	-80.3	96	"
-79.3	48.7	"	-79.1	98	"
-79.4	50	"	-78	100	"

More recent data on the above system, by Smits and Postma (1914) agree quite closely with the above except in the region of the eutectic: Ice + $\text{NH}_4\text{H}_2\text{O}$. These authors report a temperature of -100.3 instead of -120 for this point. Additional determinations are also given by Baume and Tykociner (1914). Older data for the ice curve are given by Guthrie (1884) and Pickering (1893).

SOLUBILITY IN WATER DETERMINED BY THE METHOD OF LOWERING
OF THE FREEZING-POINT. (Postma, 1920; Elliott, 1924.)

The closely agreeing determinations of these investigators were plotted on cross-section paper and the following results read from the curve.

t°.	Mole per cent NH ₃ .	Gms. NH ₃ per 100 gms. solution.	Solid Phase.	t°.	Mole per cent NH ₃ .	Gms. NH ₃ per 100 gms. solution.	Solid Phase.
0.0.....	0.0	0.0	Ice	-88.3 Eutec.	57.5	56.11	NH ₃ ·H ₂ O+2NH ₃ ·H ₂ O
-10.0.....	9.2	8.75		-87.5.....	58.0	56.63	2 NH ₃ ·H ₂ O
-20.0. . .	15.2	14.49		-85.....	59.2	57.84	»
-40.0.....	22.2	21.22		-82.5.....	60.5	59.16	»
-60.0.....	27.0	25.9		-80.....	63.0	61.69	»
-80.0.....	31.0	29.8	»	-78.2 m. pt.	66.5	65.28	»
-90.0.....	33.0	31.76		-80.....	70.5	60.36	»
-100.0 Eutec.	34.5	33.23		-85.....	76.0	75.00	»
-95.0.....	37.2	35.88	NH ₃ ·H ₂ O	-87.5.....	78.0	77.05	»
-90.0.....	40.0	38.6		-90.0.....	79.7	78.83	»
-85.0.....	43.0	41.61		-92.5 Eutec.	81.5	80.05	» +NH ₃
-80.0.....	46.5	45.1		-90.....	83.6	82.87	NH ₃
-79 m. pt.	49.5	48.08		-87.5.....	86.0	85.55	»
-80.....	52.2	50.81	»	-85.....	88.5	87.92	»
-82.5.....	54.6	53.20		-82.5.....	92.0	91.56	»
-85.0.....	56.0	54.62		-80.0.....	95.7	95.45	»
-87.5.....	57.2	55.82		-77.7.....	100.0	100.00	»

VAPOR PRESSURE OF AQUEOUS AMMONIA SOLUTIONS.
(Perman, 1903.)

Gms. NH ₃ per 100 Gms. Sol.	Vapor Pressure in mm. of Mercury at:						
	0°	10°.	20°.	30°.	40°.	50°.	60°.
0	4.5	9	17.5	31.5	55	125	149.5
2.5	13	18	32.5	56.5	91	140	234
5	20	27	47.5	83	134.5	210	327
7.5	27.5	40	79	115	183.5	281	425
10	35	54	93	153.5	241.5	363.5	539.5
12.5	45	69	118	193.5	303.5	455	666
15	57.5	89	151	245	377.5	564	816.5
17.5	75	115	191	305.5	465.5	688.5	985
20	93	144	237	393	569.5	834.5	1191
22.5	117	180.5	291	455.5	690	1005	1432
25	144.5	226.5	360	561.5	830.5	1195	...
27.5	181	280	440	680	1007	...	...
30	222	346	537	817	1189.5	...	...

The apparatus (Perman, 1901) used for the above determinations, consisted of a pipet provided with a stop-cock at its upper end and connected with a Hg leveling tube at its lower end. For maintaining constant temperatures the vessel was surrounded by a glass jacket into which water or vapors of liquids boiling at various temperatures could be introduced. The aqueous ammonia solution was drawn in above the Hg and boiled to expel air. A portion of it was withdrawn for analysis through the stop-cock at the top, by elevating the level of Hg. The vapor pressures of the analyzed mixture at various constant temperatures were then read with the aid of an adjacent millimeter scale. Curves were plotted from the results and readings for regular intervals of concentration and temperature made.

By means of a modification of the above apparatus the author was also able to estimate the partial pressure of the ammonia and of the water of each mixture. Tables for these values are given. Data have also been calculated for the latent heat of evaporation of aqueous ammonia solutions.

More recent data for the Vapor Pressure of Aqueous Solutions of Ammonia at 0° are given by Klarmann, 1924, and at 25° by Scheffer and de Wijs, 1925 and Breitenbach, 1925.

INFLUENCE OF SALTS AND OTHER COMPOUNDS ON THE VAPOR PRESSURE OF AQUEOUS AMMONIA SOLUTIONS.

(E. G. Perman, J. Chem. Soc. (Lond.), 81, 480, 1902.)

Vapor pressure determinations were made as above described on aqueous solutions of the following compositions — (a) 10.43% Urea + 16.36% NH_3 , (b) 5.29% Urea + 17.22% NH_3 , (c) 4.55% Mannitol + 12.27% NH_3 , (d) 3.05% K_2SO_4 + 7.49% NH_3 , (e) 5.27% NH_4Cl + 16.85% NH_3 , (f) 10.26% NH_4Cl + 12.9% NH_3 , (g) 2.68% CuSO_4 + 14.65% NH_3 , (h) 3.94% CuSO_4 + 6.54% NH_3 .

The author's data were plotted on cross section paper and the following values read from the curves.

t°.	Vapor Pressure of Each Solution in mm. of Mercury.							
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)
20	204	200	120	...	193	130	155	...
30	325	325	198	...	302	220	235	87
40	485	500	311	200	471	345	365	145
50	715	727	465	304	695	522	545	223
60	1050	1060	705	453	975	770	...	344

In an earlier paper Perman (1901) gives data similar to the above for the vapor pressure of ammonia in aqueous solutions of sodium sulfate.

VAPOR PRESSURE OF AQUEOUS AMMONIA SOLUTIONS.

(Sherwood, 1925.)

H₃

This author collected the available data on the partial vapor pressure of ammonia in water and plotted the results on logarithmic paper to reduce the curvature and obtain constant percentage errors. The results of Raoult, Carius, Perman, Watts, Sims, Roscoe and Ditmar, Cragoe, Myers and Taylor, Mallet, Mollier, Smits and Postma, Doryer and Gaus were used.

Gms. NH_3 per 1000 gms. H_2O .	Partial Pressure of NH_3 in mm. Hg at						
	0°	10°	20°	30°	40°	50°	60°
1000	947	...	...	...	...	...	...
900	785	...	...	...	...	...	...
800	636	987	...	...	...	...	...
700	500	780	...	...	...	...	...
600	380	600	945	...	...	...	...
500	275	439	686	...	...	...	...
400	190	301	470	719	...	...	...
300	119	190	298	454	692	...	...
250	89.5	144	227	352	534	825	...
200	64	103.5	166	260	395	596	834
150	42.7	70.1	114	179	273	405	583
100	25.1	41.8	69.6	110	167	247	361
75	17.7	29.9	50.0	79.7	120	179	261
50	11.2	19.1	31.7	51	76.5	115	165
40	...	16.1	24.9	40.1	60.8	91.1	129.9
30	...	11.3	18.2	29.6	45	67.1	94.3
25	...	...	15	24.4	37.6	55.7	77
20	...	...	12	19.3	30	44.5	61
16	...	...	...	15.3	24.1	35.5	48.7
12	...	...	...	11.5	18.3	26.7	36.3
10	...	...	...	...	15.4	22.9	30.2

AMMONIA NH_3 .

SOLUBILITY OF AMMONIA IN WATER. (Neuhausen and Patrick, 1921.)

The authors developed a static method for measuring the partial pressure of water and of ammonia over aqueous ammonia solutions. The apparatus consists of two receptacles connected respectively to each arm of a delicate manometer, in such a fashion that very small differences in pressure between the two can be very accurately measured. Into these two receptacles ammonia vapor at a certain pressure is introduced. Then into one, water vapor is successively added in small portions. The total pressure in this receptacle gradually increases until the partial pressure of the water vapor equals that corresponding to the partial pressure of water vapor over a solution, whose partial pressure of ammonia at that temperature is such as at the start. Any further addition of water vapor will entail condensation of water with consequent solution of some of the ammonia and reduction in the total pressure. When, therefore, the total pressure in the receptacle to which water vapor is added reaches a maximum, and just begins to diminish, this point shows the partial pressure of water vapor corresponding to that of the ammonia at the temperature in question. A series of such determinations were made at 0° , 20° and 40° . A curve was plotted for each temperature taking the measured partial pressures of water as the ordinates and the total pressure of ammonia plus water as abscissae. From these curves the following results, showing the partial pressure of water corresponding to regular intervals of total pressure above the aqueous solution of ammonia, were read.

Total pressure of $\text{H}_2\text{O} + \text{NH}_3$ in mm.	Partial pressure of H_2O in mm. at			Total pressure of $\text{H}_2\text{O} + \text{NH}_3$ in mm.	Partial pressure of H_2O in mm. at	
	0° .	20° .	40° .		20° .	40° .
1000	1.06	8.8	34.2	2600	4.8	18.8
1200	0.92	8.2	31.7	2800	4.5	18.5
1400	0.78	7.6	29.2	3000	4.2	18.2
1600	0.65	7.0	26.5	3200	4.0	18.1
1800	0.53	6.6	24.0	3400	3.7	17.9
2000	0.41	6.1	22.0	3600	3.5	17.4
2200	0.29	5.7	20.5	3800	3.3	17.6
2400	0.19	5.2	19.5	4000	3.1	17.5

The determinations of the *Solubility of ammonia in water* were made by repeatedly introducing ammonia into a receptacle containing a given volume of water, until no further diminution in pressure occurred after thorough shaking. By means of a special device a portion of the saturated solution was withdrawn without a material change in pressure, and thus without alteration in the content of ammonia. Successive samples were titrated and the following results were calculated from these titrations and the pressure readings.

t°.	Mole fraction per cent ammonia.	Partial pressure in mm. of		Density of solution.	Per cent contraction in volume.
		Ammonia.	Water.		
0.....	51.676	915	1.25	0.842	7.50
0.....	52.382	944	1.19	0.842	7.80
0.....	54.735	1140	0.97	0.833	7.80
0.....	61.206	1409	0.77	0.817	9.21
0.....	62.765	1499	0.708	0.812	8.52
0.....	65.076	1684	0.61	0.803	8.51
0.....	65.711	1732	0.545	0.800	8.35
0.....	66.621	1865	0.46	0.795	8.12

SOLUBILITY OF AMMONIA IN WATER. (Neuhausen and Patrick, 1921.) (Con.)

0.....	34.886	728	9.4	0.882	7.07
0.....	36.508	798	9.25	0.878	7.25
0.....	42.077	1140	8.6	0.864	8.30
0.....	42.392	1165	8.55	0.862	8.17
0.....	43.086	1226	8.4	0.854	8.16
0.....	43.731	1281	8.3	0.848	7.37
0.....	48.175	1677	7.05	0.845	8.96
0.....	49.941	1938	6.33	0.835	8.36
0.....	53.940	2655	5.1	0.825	9.47
0.....	55.970	3076	4.45	0.817	9.47
0.....	56.923	3277	4.15	0.815	9.65
0.....	25.011	752	36.5	0.902	6.05
0.....	25.366	774	36.2	0.9005	6.21
0.....	30.690	1134	32.1	0.8833	7.21
0.....	32.686	1335	29.5	0.817	7.68
0.....	33.134	1376	29.0	0.8755	7.74
0.....	36.326	1787	23.9	0.864	8.22
0.....	39.026	2180	20.5	0.856	8.52
0.....	41.133	2460	19.0	0.849	9.05
0.....	42.925	2832	18.42	0.843	10.00
0.....	44.624	3226	18.0	0.837	9.49
0.....	44.557	3214	18.0	0.837	9.42
0.....	46.335	3640	17.6	0.828	9.40

H₂

EQUILIBRIUM IN THE SYSTEM AMMONIA AND WATER AT
TEMPERATURES UP TO 150° AND PRESSURES UP TO 10 ATMOSPHERES.
(Clifford and Hunter, 1935.)

A dynamic method was used to determine the vapor compositions between 0° and 100° and for pressures up to 1.5 atmospheres. At higher ranges of temperature and pressure a static method was used. Both total vapor pressures and vapor compositions were measured. The results were plotted together with those of Perman 1903, Mollier, 1908 and Smits and Ostma, 1914 and from the curves so obtained, tables for the isobars and isotherms were constructed. The following are the values for the isobars.

Results at:

0.2 Atmospheres Pressure 0.2 Atmospheres Pressure 0.5 Atmospheres Pressure

t°	Gms. NH ₃ per 100 gms. Solution	t°	Gms. NH ₃ per 100 gms. Solution Vapor		t°	Gms. NH ₃ per 100 gms. Solution Vapor	
82.9	75.5	-61.0	100	100	-46.3	100	100
79.8	62.8	-10	31.8	99.0	-40	75.3	—
70	51.0	0	25.3	98.0	-30	60	—
60	41.5	10	20.0	95.5	-20	51.2	—
50	34.3	20	15.0	90.5	-10	43.1	—
40	27.5	30	10.0	80.0	0	37.2	—
30	21.0	40	5.5	65.5	20	26.0	97.5
20	15.0	50	2.7	38.0	40	15.0	87.5
10	9.5	60.4	0.	0.	60	6.2	63.6
0	5.0				80	0.3	4.5
10	1.7				81.7	0.	0.
17.7	0.0						

N NITROGEN AMMONIA

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EQUILIBRIUM IN THE SYSTEM AMMONIA AND WATER AT TEMPERATURES
UP TO 150° AND PRESSURES UP TO 10 ATMOSPHERES. (Continued)
(Clifford and Hunter, 1933.)

1.0 Atmosphere

t° $\frac{\text{Gms. NH}_3}{\text{Solution}}$ $\frac{\text{per 100 gms.}}{\text{Vapor}}$

-33.2	100	100
-30	86.0	—
-20	65.4	—
-10	55.3	—
0	47.3	—
10	40.6	99.2
20	34.6	98.5
30	29.1	97.0
40	24.0	94.5
50	19.0	90.2
60	14.4	82.5
70	10.0	70.0
80	6.1	52.6
90	2.9	31.8
100	0	0

H₂

2 Atmospheres

t° $\frac{\text{Gms. NH}_3}{\text{Solution}}$ $\frac{\text{per 100 gms.}}{\text{Vapor}}$

-18.5	100	100
-10	75.0	—
0	61.4	—
10	52.6	—
20	45.6	—
30	39.3	—
40	33.7	98.4
50	28.5	97.5
60	23.4	94.8
70	18.5	89.2
80	14.0	80.3
90	10.0	67.5
100	6.2	50.6
110	2.9	29.0
120	0.15	1.5
120.6	0.	0.

4 Atmospheres

t° $\frac{\text{Gms. NH}_3}{\text{Solution}}$ $\frac{\text{per 100 gms.}}{\text{Vapor}}$

-1.5	100	100
0	94.7	—
10	71.5	—
20	60.2	—
30	52.2	—
40	45.5	—
50	39.7	—
60	34.2	97.3
70	29.2	94.8
80	24.4	90.0
90	19.8	83.6
100	15.5	76.0
110	11.5	66.3
120	7.7	52.2
130	4.2	33.0
140	1.0	9.8
144.1	0.	0.

6 Atmospheres

t° $\frac{\text{Gms. NH}_3}{\text{Solution}}$ $\frac{\text{per 100 gms.}}{\text{Vapor}}$

9.7	100	100
20	74.6	—
30	62.0	—
40	54.0	—
50	47.5	—
60	41.9	—
70	36.6	97.0
80	31.4	94.2
90	26.6	90.0
100	22.0	84.8
110	17.6	78.4
120	13.5	69.9
130	9.6	57.1
140	5.9	40.0
150	2.6	19.5
159.3	0.	0.

8 Atmospheres

t° $\frac{\text{Gms. NH}_3}{\text{Solution}}$ $\frac{\text{per 100 gms.}}{\text{Vapor}}$

18.5	100	100
20	94.6	—
30	73.5	—
40	62.0	—
50	54.1	—
60	47.5	—
70	41.9	98.2
80	36.4	96.2
90	31.4	93.3
100	26.7	89.5
110	22.4	84.0
120	18.3	77.3
130	14.1	68.0
140	10.2	55.5
150	6.4	38.9
160	3.1	20.7
170	0.3	2.3
171	0.0	0.0

10 Atmospheres

t° $\frac{\text{Gms. NH}_3}{\text{Solution}}$ $\frac{\text{per 100 gms.}}{\text{Vapor}}$

25.3	100	100
30.	87.0	—
40	70.2	—
50	60.0	—
60	52.2	—
70	46.0	98.8
80	40.6	97.4
90	35.6	95.1
100	30.8	91.7
110	26.3	87.0
120	22.0	81.1
130	18.0	74.2
140	14.0	64.8
150	10.1	51.5
160	6.6	36.3
170	3.4	20.5
180.5	0.	0.

MUTUAL SOLUBILITY OF AQUEOUS AMMONIA AND POTASSIUM CARBONATE SOLUTIONS.

(Newth — J. Chem. Soc. 77, 776, 1900.)

The solutions used were: Potassium Carbonate saturated at 15° (contained 57.2 grams K_2CO_3 per 100 cc.). Aqueous Ammonia of 0.885 Sp. Gr. (contained about 33 per cent ammonia). The determinations were made by adding successive small quantities of one of the solutions to a measured volume of the other, and observing the point at which opalescence appeared.

t°.	Saturated K_2CO_3 in Aq. Ammonia.		Aq. Ammonia in Saturated K_2CO_3 .	
	cc. K_2CO_3 per 100 cc. Ammonia.	% K_2CO_3 Solution in Mixture.	cc. Ammonia in 100 cc. K_2CO_3 .	% K_2CO_3 Solution in Mixture.
I	2.0	2.0	37.5	72.7
6	3.0	3.0	47.5	67.6
11	5.0	4.7	52.5	65.0
16	6.5	6.1	60.0	63.0
21	8.5	8.0	77.5	56.3
26	10.5	9.5	105.0	49.0
31	12.5	11.1	152.5	39.0
38	20.0	16.6	195.0	33.0
39	21.0	17.0	220.0	31.0
42	25.0	20.0	250.0	28.5
43	35.0	26.0	285.0	26.5

H₂

Above 43° the solutions are completely miscible. If 10 per cent of water is added to each solution the temperature of complete miscibility is lowered to 25°. The mutual solubilities are:

t°.	Per cent K_2CO_3 Solution in:	
	Ammonia Layer.	K_2CO_3 Sol. Layer.
0	8	62
10	11	52
20	15	38
25 (crit. pt.)		25

With the addition of 12.9 per cent of water to each solution the temperature of complete miscibility (cr t. pt.) is lowered to 16°. With the addition of 18.1 per cent water this temperature becomes 0°.

SOLUBILITY OF AMMONIA IN AQUEOUS SALT SOLUTIONS.

(Raoult.)

t°.	In Calcium Nitrate Solutions Gms. NH_3 per 100 Gms. Solvent in:		In Potassium Hydroxide Solutions Gms. NH_3 per 100 Gms. Solvent in:	
	28.38% $Ca(NO_3)_2$	In 59.03% $Ca(NO_3)_2$	11.25% KOH	25.25% KOH
0	96.25	104.5	72.0	49.5
8	78.50	84.75	57.0	37.5
16	65.00	70.5	46.0	28.5
24			37.3	21.8

SOLUBILITY OF AMMONIA IN AQUEOUS SALT SOLUTIONS AT 25°.

(Abegg and Riesenfeld, 1902.)

The determinations were made by the dynamic method of vapor pressure measurement previously used by Doyer (1890), Konowalow (1898), Gahl (1900), and Gaus (1900). It consists in passing an indifferent gas through an aqueous ammonia solution of known concentration and calculating the vapor pressure from the volume of indifferent gas required to remove a definite amount of ammonia from solution. The indifferent gas ($H + O$) was generated by an electric current and its volume measured by means of a voltmeter. The accompanying ammonia was removed by passing through 0.01 n. HCl and estimated by means of electrolytic conductivity. The molecular vapor pressure was obtained by dividing the absolute vapor pressure, calculated from above measurements, by the concentration (normality) of the ammonia. For 1 n. ammonia in water at 25° the molecular vapor pressure was 13.45 mm. Hg; for 0.5 n. solution it was 13.27 mm. Hg.

Since it has been shown by much experimental evidence, that Henry's Law of the proportionality of the concentration in the liquid and vapor phase applies very closely in the present case, see also Gaus (1900), it follows that the ammonia pressure relation of two solutions of equal ammonia content is reciprocally proportional to the solubility relation of the ammonia in them. Hence, to calculate the solubility from the vapor pressures, it is only necessary to divide the value for the molecular vapor pressure in H_2O by that for the salt solution. Thus the solubility of NH_3 in H_2O becomes unity. All determinations were made with 1 n. aqueous ammonia in salt solution of 0.5, 1 and 1.5 normality. The figures therefore show mols. NH_3 per liter of the particular salt solution at 25°. In a later paper by Riesenfeld (1903), additional determinations are given for 35°.

Salt Solution.	Mols. NH_3 per Liter Salt Sol. of:			Salt Solution.	Mols. NH_3 per Liter Salt Sol. of:		
	0.5 n.	1 n.	1.5 n.		0.5 n.	1 n.	1.5 n.
KCl	0.930	0.866	0.809	KCN	0.926	0.858	0.802
KBr	0.950	0.904	0.857	KCNS	0.932	0.868	0.814
KI	0.970	0.942	0.900	K_2SO_4	0.875	0.772	0.678
KOH	0.852	0.716	0.607	K_2SO_3	0.865	0.768	0.675
NaCl	0.938	0.889	0.843	K_2CO_3	0.788	0.650	0.554
NaBr	0.965	0.916	0.890	$K_2C_2O_4$	0.866	0.771	0.675
NaI	0.995	0.992	0.985	K_2CrO_4	0.866	0.771	0.675
NaOH	0.876	0.789	0.716	CH_3COOK	0.866	0.765	0.685
LiCl	0.980	1.008	1.045	HCOOK	0.868	0.760	0.678
LiBr	1.001	1.040	1.090	KBO_2	0.814	0.677	0.560
LiI	1.030	1.094	1.190	K_2HPO_4	0.860	0.749	0.664
LiOH	0.863	0.808	0.768	Na_2S	0.887	0.795	0.726
KF	0.839	0.722	0.626	* $KClO_3$	0.927	...	...
KNO_3	0.923	0.852	0.804	* $KBrO_3$	0.940	...	...
KNO_2	0.920	0.855	0.798	* KIO_3	0.951	...	...

* These salt solutions are 0.25 normal.

Konowalow (1898) expressed the results of determinations of the solubility of ammonia in aqueous silver nitrate by the equation $H = 56.58 (m - 2n)$ in which H = partial pressure of NH_3 in mm. of Hg., m = molecular concentrations of NH_3 , and n = molecular concentration of $AgNO_3$. Similar results are given in later papers (Konowalow, 1899, *a, b*) for a large number of other salt solutions.

Gaus (1900) gives data for the vapor pressure of ammonia in aqueous 0.4 n solutions of about 20 salts, only a few of which occur in the above table.

Data for the Solubility of Ammonia in Aqueous Sodium Hydroxide Solutions at 15° are given by Miloslawskij, 1931.

SOLUBILITY OF AMMONIA IN HYDROGEN PEROXIDE DETERMINED
BY THE FREEZING-POINT METHOD. (Maass and Hatcher, 1922.)

By means of a gas buret definite volumes of ammonia were added to weighed quantities of pure hydrogen peroxide, and the freezing-points of the resulting mixtures were accurately determined.

t° of f. pt.	Gms. NH ₃ per 100 gms. mixture.	Solid Phase.	t° of f. pt.	Gms. NH ₃ per 100 gms. mixture.	Solid Phase
-1.72.....	0.0	H ₂ O ₂	9.6..	48.6	NH ₃ .H ₂ O ₂
-13	3.41	"	1.5..	49.7	"
-18	4.31	"	0.0..	50.7	"
-48 Eutec.	8.0 approx.	" + NH ₃ .H ₂ O ₂	-6.0..	51.8	"
-5	18.0	NH ₃ .H ₂ O ₂	-9.5..	52.8	"
-8	19.8	"	-32 ..	56.7	"
-15	21.1	"	-53.5..	59.5	"
-20	23.9	"	below -78 ..	61.3	"
-24.5 m. pt.	30.0 approx.	"	" ..	68.7	"

100 cc. of rubber saturated with ammonia at 21° dissolve 930 cc. NH₃ (0° and 760 mm). The determination was made by pumping out the gas with a Topley pump and measuring it over mercury. Results for the effect of pressure and temperature upon the solubility are also given. (Venable and Fuwa, 1922.)

EQUILIBRIUM IN THE SYSTEM AMMONIA AND HYDROGEN SULFIDE.
(Schefflan and McCroskey, 1932.)

The vapor pressure curve of NH₃ + H₂S was determined and also the freezing-points of their mixtures. The vapor pressure curve at 0° showed two regions of constant pressure, respectively at 80 mm and 837 mm. These correspond to the dissociation pressure of the compound NH₄HS and the pressure at which the solid compound is in equilibrium with solution and vapor at 0°. The vapor pressure temperature curve of the three phase system NH₄HS, (solid) solution and vapor was determined by two methods. The freezing-points of various mixtures of NH₃ + H₂S were also determined.

Vapor Pressures of the
Three Phase System

t°	Vapor Pressure in mm.
-21	435.5
-12	548.5
-10	581.0
-7.8	604.5
-7.5	631.5
-5.9	664.0
-5	686.0
-4	708.5
-2.5	780.0
0	838.0
2.5	917.5
5	1002.0
6.5	1075.0
7.5	1120.0
9	1201.5
10	1246.5

Freezing Points of the
system NH₃ + H₂S

t° of f. pt.	Mols. NH ₃ per 100 Mols. NH ₃ + H ₂ S	Solid Phase
-78.0	100	NH ₃
-83.5	97.5	"
-88.0 Eutec.	95.0	" + H ₂ S
-72	92.5	(NH ₄) ₂ S ₂
-60	90	"
-48.3	87.5	"
-30	82.5	"
-22.5	80.0	"
-18.0	75.0	"
+11.0	72.5	NH ₄ HS
40	70	"
79	65	"
100.8	60	"
114.5	55	"
118.0 m. pt.	50	"
-83.5	0	H ₂ S

These results show that Ammonium Sulfide, (NH₄)₂S, is stable only below -18°. On heating at this temperature it decomposes into solid cryst. NH₄HS and melt.

SOLUBILITY OF AMMONIA IN ABSOLUTE ETHYL ALCOHOL.

(Delepine — J. pharm. chim. [5] 25, 496, 1892; de Bruyn — Rec. trav. chim. 11, 112, '92.)

t°.	Density.	Gms. NH ₃ per 100 cc. Solution.	Gms. NH ₃ per 100 Gms. Solution.		Gms. NH ₃ per 100 Gms. Alcohol	
			(Delepine.)	(de Bruyn.)	(Delepine.)	(de Bruyn.)
0	0.782	13.05	20.95	19.7	26.5	24.5
5	0.784	12.00	19.00	17.5	23.0	21.2
10	0.787	10.85	16.43	15.0	19.6	17.8
15	0.789	9.20	13.00	13.2	15.0	15.2
20	0.791	7.50	10.66	11.5	11.9	13.2
25	0.794	6.00	10.0	10.0	11.0	11.2
30	0.798	5.15	9.7	8.8	10.7	9.5

According to Müller (1891), one volume of alcohol absorbs 340 volumes of ammonia at 20° and 760 mm. pressure.

SOLUBILITY OF AMMONIA IN AQUEOUS ETHYL ALCOHOL.

(Delepine.)

t°.	In 96% Alcohol.		In 90% Alcohol.		In 80% Alcohol.	
	Sp. Gr. Solution.	G. NH ₃ per 100 Gms. Sol.	Sp. Gr. Solution.	G. NH ₃ per 100 Gms. Sol.	Sp. Gr. Solution.	G. NH ₃ per 100 Gms. Sol.
0	0.783	24.5	0.800	30.25	0.808	39.0
10	0.803	18.6	0.794	28.8	0.800	28.8
20	0.788	14.8	0.795	15.8	0.821	19.1
30	0.791	10.7	0.796	11.4	0.826	12.2

t°.	In 60% Alcohol.		In 50% Alcohol.	
	Sp. Gr. Solution.	G. NH ₃ per 100 Gms. Sol.	Sp. Gr. Solution.	G. NH ₃ per 100 Gms. Sol.
0	0.830	50.45	0.835	69.77
10	0.831	37.3	0.850	43.86
20	0.842	26.1	0.869	33.8
30	0.846	21.2	0.883	25.2

SOLUBILITY OF AMMONIA IN ABSOLUTE METHYL ALCOHOL.

(de Bruyn — Rec. trav. chim. 11, 112, '92.)

t°.	G. NH ₃ per 100 Grams.		t°.	G. NH ₃ per 100 Grams.	
	Solution.	Alcohol.		Solution.	Alcohol.
0	29.3	41.5	20	19.2	23.8
5	26.5	36.4	25	16.5	20.0
10	24.2	31.8	30	14.0	16.0
15	21.6	27.8			

SOLUBILITY OF AMMONIA IN ETHYL ETHER.

(Christoff, 1912.)

Results in terms of the Ostwald Solubility Expression (see page 1136), at 0° = 17.13, at 10° = 12.35, at 15° = 10.27.

SOLUBILITY OF AMMONIA IN HYDROXYLAMINE.

(de Bruyn, 1892.)

100 gms. of the sat. solution contain 26 gms. NH₃ at ±0° and 19-20 gms. at 15°-16°.

Data for the reciprocal Solubility of gaseous Ammonia and the vapors of Methyl Alcohol, Acetone, Ether and Chloroform, determined by measuring at 25° the changes in pressure produced by adding a weighed amount of the volatile compound to a given volume of ammonia gas, are given by MacFarlane and Wright, 1934.

SOLUBILITY OF AMMONIA IN CHLOROPFORM AT 25°.

(Seward, 1932.)

A series of solutions of varying concentrations were prepared from HCl_3 which had been saturated with NH_3 , by successive dilutions with HCl_3 . These were each shaken in a closed vessel and after attainment of equilibrium, the NH_3 in both the liquid and vapor phase was determined by titration. The CHCl_3 contained 0.1 percent $\text{C}_2\text{H}_5\text{OH}$. The exact content of $\text{C}_2\text{H}_5\text{OH}$ is important since the solubility of NH_3 increases with the proportion of $\text{C}_2\text{H}_5\text{OH}$. The presence of 1.0 percent $\text{C}_2\text{H}_5\text{OH}$ was found to increase the solubility of NH_3 in CHCl_3 about 20 percent.

Gm. Mols. NH_3 per liter		Calc. Partial Pressure of NH_3 in mm. Hg	Gm. Mols. NH_3 per liter		Calc. Partial Pressure of NH_3 in mm. Hg
CHCl_3 phase	Vapor phase		CHCl_3 phase	Vapor phase	
0.0393	0.000756	14.0	0.423	0.00814	151.3
0.0888	0.001716	31.9	0.661	0.0132	245.4
0.1157	0.002215	41.2	0.851	0.0175	325.4
0.246	0.00474	88.1	1.105	0.0244	453.5
0.392	0.00749	139.2			

The partial pressures of NH_3 were calculated from the concentration of the NH_3 in the vapor phase, assuming Dalton's law to hold and neglecting the deviations of ammonia gas from the perfect gas law. The d. of the CHCl_3 was 1.480 at 25° and that of the solution containing 1.415 gm. mols. NH_3 per liter was 1.450. These figures were used in calculating the concentrations of NH_3 to volume of liquid phase.

SOLUBILITY OF AMMONIA IN SEVERAL SOLVENTS AT 20° AND 760mm. PRESSURE.

(Bell, 1931.)

The solvents were saturated with NH_3 and the amount of gas present in a known amount of the saturated solution determined by removing it with a current of air, absorbing in an excess of HCl and titrating.

Solvent	S	X	Solvent	S	X
Hexane	4.16	0.0223	Toluene	7.24	0.0314
Octane	2.56	0.0170	Chloroform	69.8	0.1930
Dodecane	2.13	0.0197	Bromobenzene	8.08	0.0480
Octane	1.84	0.0210	Chlorobenzene	11.45	0.0423
Carbon Tetrachloride	7.17	0.0281	Benzyl chloride	13.20	0.0556
Benzene	9.95	0.0474	Ethylene chloride	26.6	0.0797

s = the partition coefficient of NH_3 between the liquid and the vapor, that is, $s = c$ (the gm. equiv. NH_3 per liter) \div 0.0417 and $s/c = 22.4 \times 273/273$.

x = the mol. fraction (gm. mol. NH_3 per 1.0 gm. mol. NH_3 + solvent) calculated on the assumption that the densities of the solutions obey the ideal mixture law.

One liter of Cyclohexanol ($\text{C}_6\text{H}_{11}\text{OH}$) dissolve 28,166.7 cc Ammonia (NH_3) at 26° and 755 mm. pressure. (Cauquil, 1927.)

AMMONIA

The solubility of AMMONIA in NITROBENZENE, in terms of the Bunsen Absorption Coefficient, (see p. 1136) is 18.37 at 15°, 12.61 at 25° and 8.257 at 40° (Baars, 1927)

Freezing-point Data are given for:

H_3	$NH_3 + CH_3OH$	(Baume and Perrot, 1910, 1914.)
	" + $(CH_3)_2O$	" " " "
	" + C_2H_5OH	(Broderston, 1911.)
	" + $n CH_3CH_2CH_2OH$	(Cady and Jones, 1933.)
	" + iso $CH_3CH(CH_3)CHOH$	" " "
	" + $n CH_3(CH_2)_2CH_2OH$	" " "
	" + iso $(CH_3)_2CHCH_2OH$	" " "
	" + sec. $CH_3CH_2CHOHCH_3$	" " "
	" + ter. $(CH_3)_3COH$	" " "
	" + C_6H_5OH	(Briner and Agathon, 1926.)
	" + H_2S	(Scheffer, 1912.)
	" + NH_4Br	(Kendall and Davidson, 1922.)
	" + NH_4Cl	" " "
	" + NH_4I	" " "
	" + NH_4ClO_4	(Mazetti and Decarli, 1926.)
	" + NH_4NO_3	(Kurilloff, 1898.)
	" + NH_4CNS	(Bradley and Alexander, 1912; Foote, 1920; Foote and Hunter, 1920.)
	" + $(NH_4)_2CO_3$	(Jänecke and Rahlfo, 1930.)
	" + $CS(NH_4)_2$	(Jänecke and Hoffmann, 1932.)
	" + Li	(Ruff and Geisel, 1906.)
	" + K	" " "
	" + Na	" " "
	" + S	(Ruff and Hecht, 1911.)

DISTRIBUTION OF AMMONIA BETWEEN CARBON TETRA CHLORIDE AND AIR AT 15°.
(Roederer, 1936.)

The experiments were made by shaking CCl_4 containing NH_3 with air or by shaking CCl_4 with air containing NH_3 .

Gm. Mols. NH_3 per liter:		(c)	Gm. Mols. NH_3 per liter:		(c)
CCl_4 (c)	Air (a)	(a)	CCl_4 (c)	Air (a)	(a)
0.0114	0.0016	7.13	0.0899	0.0123	7.31
0.0222	0.00325	6.83	0.1351	0.0188	7.19
0.0533	0.0072	7.40	0.1632	0.0222	7.35
0.0618	0.0087	7.11	0.1668	0.0229	7.28
0.0763	0.0106	7.20	0.1700	0.0228	7.45

One liter of CCl_4 saturated with ammonia at 15° and under 760mm partial pressure contains 0.306 gm. mols. NH_3 .

DISTRIBUTION OF AMMONIA BETWEEN:

Water and Amyl Alcohol at 20°.

(Herz and Fischer — Ber. 37, 4747, '04)

Gms. NH ₃ per 100 cc.		G. M. NH ₃ per 100 cc.	
Aq. Layer	Alcoholic Layer.	Aq. Layer.	Alcoholic Layer.
0.5	0.072	0.25	0.0035
1.0	0.147	0.50	0.0073
2.0	0.272	1.00	0.0148
3.0	0.438	2.00	0.0295
4.0	0.595	3.00	0.0460
5.0	0.756		

Water and Chloroform at 20°.

(Dawson and McCrae — J. Ch. Soc. 70, 496, '01; see also Hantsch and Sebaldt — Z. phys. Ch. 30, 258, '99.)

Gms. NH ₃ per 100 cc.		G. M. NH ₃ per 100 cc.	
Aq. Layer	CHCl ₃ Layer.	Aq. Layer.	CHCl ₃ Layer.
0.2	0.007	0.01	0.00038
0.4	0.015	0.02	0.00073
0.6	0.023	0.03	0.00114
0.8	0.031	0.04	0.00152
1.0	0.039	0.05	0.00193
1.2	0.046	0.06	0.00232
1.4	0.055	0.08	0.00311
1.6	0.063	0.10	0.00396

Additional data for the distribution of ammonia between water and chloroform are given by Dawson and McCrae (1900), (1901a), (1901b); Dawson (1906), (1909); Abbott and Bray (1907); Sherrill and Russ (1907); Bell (1911), and by Moore and Winnill (1912). The results show that with increase of concentration of ammonia, the relative amount in the aqueous layer diminishes. Thus Bell found that at 25° the distribution ratio is 22.7 when the aqueous layer contains 1.02 gm. mols. NH₃ per liter and only 10 when 12.23 gm. mols. NH₃ are present in the aqueous layer. The influence of increase of temperature was also found to be in the direction of diminution of the relative amount in the aqueous layer.

The influence of the presence of a large number of salts in the aqueous layer has been studied by several of the above-mentioned investigators. In the case of copper, zinc and cadmium salts (Dawson and McCrae, 1900), (Dawson, 1909), the distribution ratio varied with salt concentration in a manner indicating that metal ammonia compounds were formed.

Results for the effect of KOH, NaOH and Ba(OH)₂ on the distribution at 18° are given by Dawson (1909).

Results for the effect of ammonium chromate upon the distribution at 25° are given by Sherrill and Russ (1907).

Results for the distribution of ammonia between water and mixtures of chloroform and amyl alcohol at 25° are given by Herz and Kurzer (1910).

DISTRIBUTION OF AMMONIA BETWEEN TOLUENE AND AIR.

(Hantzsch and Vagt, 1901)

t°.	Gms. NH ₃ per 1000 cc.		Mols. NH ₃ per 1000 cc.	
	C ₆ H ₅ CH ₃ Layer.	Air.	C ₆ H ₅ CH ₃ Layer.	Air.
0	0.366	0.0396	0.0215	0.00233
10	0.357	0.0435	0.0210	0.00256
20	0.326	0.0451	0.0192	0.00265
30	0.286	0.0462	0.0168	0.00272

DISTRIBUTION OF AMMONIA BETWEEN WATER AND CHLOROFORM AT 25°.

(Occleshaw, 1931.)

(Dietrick, 1929.)

(Matthews and Davies, 1933)

Gm. Mols. NH_3 per liter		Gm. Mols. NH_3 per 1000 gms.		Gm. Mols. NH_3 per 1000 gms.		(a)
Aqueous layer (a)	CHCl_3 layer (c)	Aqueous layer (a)	CHCl_3 layer (c)	Aqueous layer (a)	CHCl_3 layer (c)	
0.1388	0.00579	0.02183	0.0005936	0.1289	0.003587	35.93
0.2330	0.00978	0.03203	0.0008735	0.4976	0.01408	35.33
0.3232	0.01360	0.04610	0.001263	0.7796	0.02220	34.98
0.3835	0.01624	0.04983	0.001701	1.0264	0.02957	34.71
0.4677	0.01993	0.05871	0.001611	3.2678	0.06762	33.54
0.4868	0.02074	0.1011	0.002772	3.0349	0.09233	32.87

$$\frac{(a)}{(c)} = 23.64$$

$$\frac{(a)}{(c)} = 35.83$$

Data for the distribution of Ammonia between Chloroform and aqueous solutions containing various concentrations of both ammonium chloride and magnesium chloride at 18° are given by Fredholm, 1934.

Data for the distribution of ammonia between toluene and aqueous silver ammonium chloride and hydroxide at 25° are given by (Randall and Halford, 1930.).

THE SYSTEM AMMONIA, ARSENIC TRIOXIDE AND WATER AT 30°.

(Schreinemakers and de Baat, 1915)

Gms. per 100 Gms. Sat. Sol.		Solid Phase.	Gms. per 100 Gms. Sat. Sol.		Solid Phase.
NH_3 .	As_2O_3 .		NH_3 .	As_2O_3 .	
0	2.26	As_2O_3	3.13	12.30	NH_4AsO_2
1.41	10.98	"	3.91	7.63	"
2.78	20.49	"	6.95	4.72	"
2.86	21.17	"	9.93	3.20	"
2.88	18.43	NH_4AsO_2	4.28	2.16	"

Data are also given for the system $\text{NH}_4\text{Cl} + \text{As}_2\text{O}_3 + \text{H}_2\text{O}$ at 30°.

100 gms. H_2O dissolve 0.02 gm. NH_4Cl and As_2O_3 (Field, 1873)

" " " 0.014 " $\text{NH}_4\text{MgAsO}_4 \cdot \frac{1}{2}\text{H}_2\text{O}$.

SOLUBILITY OF AMMONIUM MAGNESIUM ARSENATE IN WATER AND IN AQUEOUS SOLUTIONS OF AMMONIUM SALTS.

(Wenger, 1911.)

Gms. $\text{NH}_4\text{MgAsO}_4$ per 100 Gms. of Each Solvent.

t°.	Water.	Aq. 5% NH_4NO_3 .	Aq. 5% NH_4Cl .	Aq. NH_4OH .	Aq. $\text{NH}_4\text{OH} + 10\% \text{HCl}$.	Aq. $\text{NH}_4\text{OH} + 10\% \text{NH}_4\text{Cl}$.	Solid Phase.
0	0.0339	0.092	0.084	0.0087	...	...	$\text{NH}_4\text{MgAsO}_4 \cdot 6\text{H}_2\text{O}$
20	0.0207	0.114	0.113	0.0096	0.013	0.032	"
30	...	0.118	0.113	...	...	...	"
40	0.0275	0.139	0.190	0.0117	...	...	"
50	0.0226	0.189	0.189	0.0100	...	...	"
60	0.0210	0.211	0.219	0.0090	0.047	0.054	"
70	0.0156	0.189	0.221	0.0095	...	...	"
80	0.0236	0.189	0.231	0.0091	...	...	"

* Composed of 1 part NH_3 (d = 0.96) + 4 parts H_2O .

† Contained 4 parts NH_3 (d = 0.96) per 100 parts NH_4Cl solution.

AMMONIUM ARSENATE $\text{NH}_4\text{H}_2\text{AsO}_4$.

SOLUBILITY OF MONO AMMONIUM ARSENATE IN WATER.

(de Passille, 1932.)

t°	d. of sat. sol.	Gms. $\text{NH}_4\text{H}_2\text{AsO}_4$ per 100 gms. H_2O	Solid Phase	t°	d. of sat. sol.	Gms. $\text{NH}_4\text{H}_2\text{AsO}_4$ per 100 gms. H_2O	Solid Phase
0	1.1814	33.74	$\text{NH}_4\text{H}_2\text{AsO}_4$	60	1.4864	83.05	$\text{NH}_4\text{H}_2\text{AsO}_4$
20	1.2280	48.67	"	80	1.4200	107.25	"
40	1.2821	63.83	"	90	1.4623	122.4	"

The author also prepared the Di and Tri Ammonium Arsenates but these decompose with loss of ammonia in aqueous solution.

AMMONIUM BORATES $(\text{NH}_4)_2\text{O} \cdot 2\text{B}_2\text{O}_3 \cdot 4\text{H}_2\text{O}$, $(\text{NH}_4)_2\text{O} \cdot 5\text{B}_2\text{O}_3 \cdot 8\text{H}_2\text{O}$.

SOLUBILITY OF AMMONIUM DI BORATE IN WATER.

(Menzel, 1927.)

B(1)

t°	Gms. $(\text{NH}_4)_2\text{O} \cdot 2\text{B}_2\text{O}_3$ per 100 gms. sat. solution	Gms. sat. solution	Solid Phase
18	7.06	6.78	$(\text{NH}_4)_2\text{O} \cdot 2\text{B}_2\text{O}_3 \cdot 4\text{H}_2\text{O}$
25	9.22	8.76	"

SOLUBILITY OF AMMONIUM PENTA BORATE IN WATER.

(Sborgi and Ferri, 1921; Menzel, 1927; Bullet and Andrea, 1930.)

t°	Gms. $(\text{NH}_4)_2\text{O} \cdot 5\text{B}_2\text{O}_3$ per 100 gms. sat. sol.	Solid Phase	t°	Gms. $(\text{NH}_4)_2\text{O} \cdot 5\text{B}_2\text{O}_3$ per 100 gms. sat. sol.	Solid Phase
0	4.0	$(\text{NH}_4)_2\text{O} \cdot 5\text{B}_2\text{O}_3 \cdot 8\text{H}_2\text{O}$	40	9.0	$(\text{NH}_4)_2\text{O} \cdot 5\text{B}_2\text{O}_3 \cdot 8\text{H}_2\text{O}$
10	5.2	"	40	11.4	"
20	6.9	"	50	14.2	"
25	8.0	"	60	18.2	"

AMMONIUM Di BORATE, Penta BORATE, etc.

EQUILIBRIA IN THE SYSTEM AMMONIA, BORIC ANHYDRIDE AND WATER
AT VARIOUS TEMPERATURES.

(At 30°, Sborgi, 1912 and 1913; at 30° and 60°, Sborgi and Mecacci, 1915 and 1916; at 0° and 100°, Sborgi and Mezzetti, 1921; at the other temperatures, Sborgi and Ferri, 1921 and 1922.)

The numerous determinations were plotted on cross section paper and the following tables constructed from the curves.

Gms. per 100 gms. sat. sol.		Gms. per 100 gms. sat. sol.		Gms. per 100 gms. sat. sol.		Gms. per 100 gms. sat. sol.		Solid Phase at Each Temperature.
(NH ₄) ₂ O.	B ₂ O ₃ .	(NH ₄) ₂ O.	B ₂ O ₃ .	(NH ₄) ₂ O.	B ₂ O ₃ .	(NH ₄) ₂ O.	B ₂ O ₃ .	
t = 0°.		t = 10°.		t = 20°.		t = 30°.		
0.0	1.46	0.0	1.96	0.0	2.70	0.0	3.60	H ₃ BO ₃
0.2	2.2	0.2	3.0	0.2	3.7	0.2	4.7	"
0.3	2.8	0.4	4.0	0.4	4.8	0.5	6.1	"
0.37	3.26	0.5	4.4	0.5	5.5	0.8	7.6	" + 1.5.8
0.5	3.5	0.8	5.0	1.0	6.4	1.5	8.8	1.5.8
0.75	4.0	1.2	5.9	1.5	7.6	2.2	10.5	"
1.0	4.5	1.6	7.1	2.0	8.9	3.0	12.7	"
1.3	5.4	2.0	8.2	2.8	10.8	3.8	15.3	" + 1.2.4
1.0	4.0	1.8	7.0	2.5	9.0	3.5	13.3	1.2.4
0.9	3.2	1.6	5.0	2.2	6.7	3.0	9.0	"
1.0	2.8	1.5	3.6	2.5	4.2	4.0	6.0	"
2.0	2.5	2.0	3.0	3.0	3.8	6.0	5.0	"
4.0	2.3	4.0	2.6	4.0	3.3	10.0	3.5	"
10.0	1.8	10.0	2.0	10.0	2.4	15.0	2.5	"
20.0	1.0	20.0	1.1	20.0	1.4	20.0	1.8	"
t = 40°.		t = 50°.		t = 60°.		t = 90°.		
0.0	4.5	0.0	5.3	0.0	7.4	0.0	13.5	H ₃ BO ₄
0.5	6.8	0.5	8.0	0.5	10.4	1.0	18.0	"
0.9	9.5	1.0	10.6	1.4	15.6	2.4	25.0	" + 1.5.8
1.5	9.9	1.5	11.0	2.0	16.0	3.0	25.4	1.5.8
2.0	10.7	2.0	11.9	3.0	15.7	4.0	26.5	"
3.0	13.0	3.0	14.0	3.5	19.0	5.0	28.4	"
3.5	14.7	3.6	16.4	4.0	20.6	6.1	31.5	" + 1.4.6
3.8	15.3	4.0	16.9	5.0	22.0	8.0	34.0	1.4.6
4.0	15.6	4.5	17.6	6.0	23.8	10.0	36.8	"
4.5	16.3	5.0	18.5	7.0	26.0	12.0	39.7	"
4.9	17.5	5.6	19.8	7.9	27.8	12.8	40.7	" + 1.2.4
4.2	12.0	5.0	14.0	7.5	21.0	13.0	39.0	1.2.4
6.0	7.6	6.0	9.0	8.0	17.0	14.0	35.0	"
10.0	5.0	10.0	6.0	10.0	12.6	16.0	28.5	"
20.0	2.4	20.0	3.0	20.0	5.6	20.0	23.3	"
30.0	1.0	30.0	1.6	30.0	3.0	30.0	19.0	"

1.5.8 = (NH₄)₂O.5B₂O₃.8H₂O; 1.2.4 = (NH₄)₂O.2B₂O₃.4H₂O; 1.4.6 = (NH₄)₂O.4B₂O₃.6H₂O.

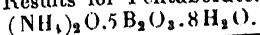
The authors also made numerous determinations at 31°, 31.5°, 32° and 35° in order to ascertain the composition of solutions in contact with the 1.4.6 compound near its transition temperature.

The cryohydric points are as follows:

Gms. per 100 gms. sat. sol.		Solid Phase.	Gms. per 100 gms. sat. sol.		Solid Phase.
t°.	(NH ₄) ₂ O. B ₂ O ₃ .		t°.	(NH ₄) ₂ O. B ₂ O ₃ .	
-1.37...	0.58 3.92	Ice + 1.5.8	-1.30...	1.01 1.03	Ice + 1.2.4
-1.25...	0.36 3.02	" + " + H ₃ BO ₃	-8.5...	3.57 0.85	"
-2.05...	1.21 4.97	" + " + 1.2.4	-15.0...	17.61 0.57	"
-1.08...	0.54 1.47	" + 1.2.4	+31 tr. pt.	3.63 13.59	1.5.8 + 1.4.6 + 1.2.4

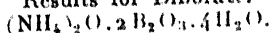
SOLUBILITY OF AMMONIUM PENTABORATE AND OF AMMONIUM DIBORATE IN WATER. (Sborgi and Ferri, 1921; Sborgi and Gallichi, 1924.)

Results for Pentaborate.



t°.	Gms. (NH ₄) ₂ O · 5B ₂ O ₃ per 100 gms. sat. sol.	t°.	Gms. (NH ₄) ₂ O · 5B ₂ O ₃ per 100 gms. sat. sol.
1.37 (cryo.)..	3.92	40..	11.40
0.....	3.95	45..	12.81
10.....	5.39	60..	18.25
20.....	7.07	75..	24.40
30.....	9.10	90..	30.29
35.....	10.02		

Results for Diborate.



t°.	Gms. (NH ₄) ₂ O · 2B ₂ O ₃ per 100 gms. sat. sol.	t°.	Gms. (NH ₄) ₂ O · 2B ₂ O ₃ per 100 gms. sat. sol.
- 1.08 (cryo.)..	3.62	35..	13.02
0.....	3.75	40..	15.77
10.....	5.26	45..	18.41
20.....	7.63	60..	27 interp.
25.....	9.00	65..	30.80
30.....	10.80	90..	52.68

SIMULTANEOUS SOLUBILITY OF AMMONIUM DIBORATE AND OTHER SALTS IN WATER AT 0°, 16° AND 25°. (Sborgi and Franco, 1921.)

Gms. equivalents per 1000 gms. mols. H₂O.

NH ₄ Cl.	NaCl.	Na ₂ B ₄ O ₇ .	(NH ₄) ₂ B ₄ O ₇ .	Solid Phase.
97.92	.....	.....	4.35	(NH ₄) ₂ B ₄ O ₇ · 4H ₂ O + NH ₄ Cl
.....	.....	1.52	6.38	" + Na ₂ B ₄ O ₇ · 10H ₂ O
.....	108.06	0.85	.....	NaCl + " + NH ₄ Cl
49.33	85.79	1.58	.....	" + " + NH ₄ Cl
58.71	69.14	1.92	.....	Na ₂ B ₄ O ₇ · 10H ₂ O + NH ₄ Cl
68.87	48.82	1.97	.....	" "
74.10	40.57	2.92	.....	" "
87.14	21.22	3.77	.....	" + (NH ₄) ₂ B ₄ O ₇ · 4H ₂ O
74.98	17.06	3.57	.....	" + (NH ₄) ₂ B ₄ O ₇ · 4H ₂ O
48.71	10.84	3.22	.....	" "
.....	.....	2.35	9.88	" "
111.66	.....	.....	5.06	NH ₄ Cl + " "
.....	109.22	0.97	.....	NaCl + Na ₂ B ₄ O ₇ · 10H ₂ O
39.20	91.52	2.25	.....	" "
61.38	80.33	2.34	.....	" + NH ₄ Cl
76.50	51.42	3.99	.....	Na ₂ B ₄ O ₇ · 10H ₂ O + " "
91.50	30.14	5.00	.....	" "
95.05	25.98	6.30	.....	" + (NH ₄) ₂ B ₄ O ₇ · 4H ₂ O
73.94	18.09	5.71	.....	" + (NH ₄) ₂ B ₄ O ₇ · 4H ₂ O
58.70	12.35	4.74	.....	" "
112.7	0.03	4.41	.....	NH ₄ Cl + " "
132.10	.....	.....	10.40	" "
.....	.....	6.25	19.96	Na ₂ B ₄ O ₇ · 10H ₂ O + " "
.....	109.53	1.80	.....	" + NaCl
85.16	71.49	9.80	.....	" + " + NH ₄ Cl
97.99	50.00	13.00	.....	" + " + NH ₄ Cl
105.52	38.32	14.83	.....	" + " + (NH ₄) ₂ B ₄ O ₇ · 4H ₂ O
93.90	32.00	13.90	.....	" + (NH ₄) ₂ B ₄ O ₇ · 4H ₂ O
78.90	25.00	12.80	.....	" "

The authors discuss the application of the results to the technical production of borax and elaborate this phase of the subject in a subsequent paper.

(Sborgi and Franco, 1922.)

RECIPROCAL SOLUBILITY OF AMMONIUM DIBORATE AND AMMONIUM SULFATE IN WATER AT THE CRYOHYDRIC TEMPERATURES. (Sborgi and Bovolini, 1923.)

t°.	Gms. equiv. per 100 gms. mols. H ₂ O.		Gms. per 100 gms. H ₂ O.		Gms. per 100 gms. sat. sol.		Solid Phase.
	(NH ₄) ₂ SO ₄ .	(NH ₄) ₂ B ₄ O ₇ .	(NH ₄) ₂ SO ₄ .	(NH ₄) ₂ B ₄ O ₇ .	(NH ₄) ₂ SO ₄ .	(NH ₄) ₂ B ₄ O ₇ .	
19.34.	179.53	2.441	65.79	1.300	39.68	1.28	(NH ₄) ₂ B ₄ O ₇ · 4H ₂ O + (NH ₄) ₂ SO ₄ + Ice
16.32.	180.50	3.50	66.15	1.865	39.81	1.83	(NH ₄) ₂ B ₄ O ₇ · 4H ₂ O + (NH ₄) ₂ SO ₄

RECIPROCAL SOLUBILITY OF AMMONIUM BIBORATE AND AMMONIUM SULFATE
IN WATER AT SEVERAL TEMPERATURES. (Shorgi and Gallichi, 1924.)

Results at 10° :		Results at 20° :		Results at 30° :		Solid Phase at Each Temperature.
Gms. per 100 gms. sat. sol.		Gms. per 100 gms. sat. sol.		Gms. per 100 gms. sat. sol.		
(NH ₄) ₂ SO ₄ .	(NH ₄) ₂ B ₄ O ₇ .	(NH ₄) ₂ SO ₄ .	(NH ₄) ₂ B ₄ O ₇ .	(NH ₄) ₂ SO ₄ .	(NH ₄) ₂ B ₄ O ₇ .	
0.0	5.255	3.25	6.39	0.0	20.88	(NH ₄) ₂ B ₄ O ₇ ·4H ₂ O
8.295	3.018	22.80	3.204	16.31	13.73	"
37.09	1.807	38.369	2.48	31.29	10.01	"
41.10	1.60	41.40	2.36	41.14	8.60	" + (NH ₄) ₂ SO ₄
42.20	0.0	42.99	0.0	45.77	0.0	(NH ₄) ₂ SO ₄

Results at 25° :		Results at 35° :		Solid Phase at Each Temperature.
Gms. per 100 gms. sat. sol.		Gms. per 100 gms. sat. sol.		
(NH ₄) ₂ SO ₄ .	(NH ₄) ₂ B ₄ O ₇ .	(NH ₄) ₂ SO ₄ .	(NH ₄) ₂ B ₄ O ₇ .	
0.0	8.998	0.0	13.02	(NH ₄) ₂ B ₄ O ₇ ·4H ₂ O
5.17	6.747	1.594	11.803	"
13.07	5.10	2.518	11.326	"
23.865	4.052	14.92	7.413	"
29.65	3.518	19.50	6.672	"
37.186	3.1388	25.19	5.881	"
41.20	2.886	36.38	4.70	"
41.62	2.83	41.56	4.214	"
42.17	2.016	43.17	1.69	" + (NH ₄) ₂ SO ₄
43.06	0.65	44.22	0.0	(NH ₄) ₂ SO ₄
43.41	0.0			"

The cryohydric temperature of the system (NH₄)₂B₄O₇ + Na₂B₄O₇ + Ice is — 1° 22 and 100 gms. of the saturated solution contain 3.472 gms. of (NH₄)₂B₄O₇ and 0.6447 gm. of Na₂B₄O₇. (Shorgi and Gallichi, 1924.)

RECIPROCAL SOLUBILITY OF AMMONIUM BIBORATE AND SODIUM BIBORATE
IN WATER AT VARIOUS TEMPERATURES. (Shorgi and Gallichi, 1924.)

Gms. per 100 gms. sat. sol.			Solid Phase.	Gms. per 100 gms. sat. sol.			Solid Phase.
t°.	Na ₂ B ₄ O ₇ .	(NH ₄) ₂ B ₄ O ₇ .		t°.	Na ₂ B ₄ O ₇ .	(NH ₄) ₂ B ₄ O ₇ .	
0..	0.844	3.216	AB.4 + SB.10	45..	10.00	18.62	AB.4 + SB.10
10..	1.37	1.20	SB.10	45..	8.38	8.45	SB.10
10..	1.24	4.32	"	50.5	12.3	21.21	AB.4
10..	1.237	4.91	" + AB.4	50.5	13.83	21.16	" + SB.10
10..	0.93	4.96	AB.4	50.5	13.74	21.10	" + SB.5
16..	1.83	6.60	" + SB.10	50.5	13.31	18.18	SB.10
20..	2.22	7.73	"	55..	13.23	23.58	AB.4
30..	3.42	11.02	AB.4	55..	17.46	23.47	" + SB.5
30..	4.08	11.19	" + SB.10	55..	17.33	19.62	SB.5
30..	3.86	8.81	SB.10	55..	17.30	19.30	SB.5 + SB.10
25..	1.19	9.12	AB.4	55..	15.92	13.52	SB.10
25..	2.96	9.26	"	55..	14.03	5.88	"
25..	3.07	9.27	" + SB.10	57..	17.60	24.60	AB.4 + SB.5
25..	3.06	8.77	SB.10	57..	17.27	15.88	SB.5
25..	3.03	8.16	"	57..	17.25	14.28	" + SB.10
25..	3.01	7.73	"	57..	16.29	11.07	SB.10
25..	2.97	6.26	"	65..	18.62	29.00	AB.4
35..	3.42	13.27	AB.4	65..	19.36	28.94	" + SB.5
35..	5.54	13.42	" + SB.10	65..	19.25	22.01	SB.5
35..	5.12	9.82	SB.10	65..	18.70	10.70	"
35..	4.63	3.29	"	65..	18.30	5.33	"

AB.4 = (NH₄)₂B₄O₇·4H₂O; SB.10 = Na₂B₄O₇·10H₂O; SB.5 = Na₂B₄O₇·5H₂O.

Results for aqueous solutions saturated with respect to :

olid Phase $(\text{NH}_4)_2\text{B}_4\text{O}_7 \cdot 4\text{H}_2\text{O} + \text{Na}_2\text{B}_4\text{O}_7 \cdot 5\text{H}_2\text{O}$.
olid Phase $\text{Na}_2\text{B}_4\text{O}_7 \cdot 5\text{H}_2\text{O} + \text{Na}_2\text{SO}_4$.

BO

°.	(NH ₄) ₂ NaSO ₄ ·4H ₂ O + Na ₂ SO ₄ ·10H ₂ O + Na ₂ B ₄ O ₇ ·10H ₂ O			(NH ₄) ₂ NaSO ₄ ·4H ₂ O + (NH ₄) ₂ B ₄ O ₇ ·10H ₂ O + Na ₂ B ₄ O ₇ ·10H ₂ O		
	Gms. equiv.	per 1000 gms.	mols. H ₂ O	Gms. equiv.	per 1000 gms.	mols. H ₂ O
	(NH ₄) ₂ SO ₄	Na ₂ SO ₄	Na ₂ B ₄ O ₇	(NH ₄) ₂ SO ₄	Na ₂ SO ₄	Na ₂ B ₄ O ₇
-10.5..	157.67	14.44	3.09	166.15	10.68	2.76
-10....	156.12	14.828	3.259	157.25	14.422	2.80
0....	129.73	26.30	4.75	132.14	22.00	5.00
-10....	106.39	42.54	5.25	116.494	37.143	7.577
15....	93.0	59.0	5.50	113.56	43.80	9.45
25....	62.630	104.573	5.884	114.0	54.180	14.909
25.65.	62.13	108.76	6.00	114.93	53.94	15.98
26....	63.5	107.4	7.66	113.5	54.5	15.5
26....	61.0	110	3.50	60.0	109	6.50
30....	73.0	101.5	11.06	114.0	52.5	19.5
35....	89.817	89.849	17.571 ^b	116.786	60.119	28.18 ^b
38.7..	118.45	63.73	36.49 ^c (30 ^a)	20.0	119.0	4.0 ^d
lid Phase	(NH ₄) ₂ NaSO ₄ ·4H ₂ O	+ Na ₂ SO ₄ ·10H ₂ O	+ Na ₂ SO ₄	+ Na ₂ B ₄ O ₇ ·10H ₂ O		
"	"	+ Na ₂ B ₄ O ₇ ·10H ₂ O	+ "			
"	"	+ Na ₂ SO ₄ ·10H ₂ O	+ "			
"	Na ₂ B ₄ O ₇ ·10H ₂ O	+ "	+ "			
"	"	+ (NH ₄) ₂ NaSO ₄ ·4H ₂ O	+ "	+ (NH ₄) ₂ B ₄ O ₇ ·10H ₂ O		

$(\text{NH}_4)_2\text{Na}_2\text{SO}_4 \cdot 3\text{H}_2\text{O} + \text{Na}_2\text{SO}_4$ + $(\text{NH}_4)_2\text{B}_4\text{O}_7 \cdot 5\text{H}_2\text{O}$				$(\text{NH}_4)_2\text{B}_4\text{O}_7 \cdot 5\text{H}_2\text{O} + \text{Na}_2\text{SO}_4$ + $\text{Na}_2\text{B}_4\text{O}_7 \cdot 10\text{H}_2\text{O}$			
	Gms. eq. dv.	per 1000 gms.	moles H_2O		Gms. eq. dv.	per 1000 gms.	moles H_2O
	$(\text{NH}_4)_2\text{SO}$	Na_2SO_4	$(\text{NH}_4)_2\text{B}_4\text{O}_7$		$\text{NH}_4)_2\text{SO}$	Na_2SO_4	$\text{Na}_2\text{B}_4\text{O}_7$
...	135.09	79.81	27.75		119.50	69.75	42.25
7...	152.42	74.45	28.65		111.78	69.65	48.43
0...	165.76	76.42	33.25		121.44	58.86	52.19 ^b
0...	171.08	84.99	43.63		128.54	42.46	67.29 ^b
0...	168.61	99.26	60.53		140.63	26.78	94.09 ^b

lud Phase also contains, $\text{Na}_2\text{B}_4\text{O}_7 \cdot 5\text{H}_2\text{O}$. ^b Solid Phase: $(\text{NH}_4)_2\text{B}_4\text{O}_7 \cdot 5\text{H}_2\text{O} + \text{Na}_2\text{SO}_4$
+ $\text{Na}_2\text{B}_4\text{O}_7 \cdot 5\text{H}_2\text{O}$

EQUILIBRIUM IN THE SYSTEM $(\text{NH}_4)_2\text{B}_4\text{O}_7 + \text{Na}_2\text{SO}_4 \rightleftharpoons \text{Na}_2\text{B}_4\text{O}_7 + (\text{NH}_4)_2\text{SO}_4$ (Con.).

Results for aqueous solutions saturated with respect to :

$(\text{NH}_4)_2\text{B}_4\text{O}_7 \cdot 4\text{H}_2\text{O}$ $+ (\text{NH}_4)\text{NaSO}_4 \cdot 4\text{H}_2\text{O} + (\text{NH}_4)_2\text{SO}_4$ Gm. equiv. per 1000 gm. mols. H_2O .				$(\text{NH}_4)_2\text{B}_4\text{O}_7 \cdot 4\text{H}_2\text{O}$ $+ (\text{NH}_4)\text{NaSO}_4 \cdot 4\text{H}_2\text{O} + (\text{NH}_4)_2\text{SO}_4$ Gm. equiv. per 1000 gm. mols. H_2O .			
t°.	$(\text{NH}_4)_2\text{SO}_4$.	Na_2SO_4 .	$(\text{NH}_4)_2\text{B}_4\text{O}_7$.	t°.	$(\text{NH}_4)_2\text{SO}_4$.	Na_2SO_4 .	$(\text{NH}_4)_2\text{B}_4\text{O}_7$.
-10.5.	177.52	9.71	2.60	35...	195.54	44.41	17.54
-10...	177.55	9.85	2.60	38.7.	195.21	49.21	21.26
0...	182.918	18.101	4.685	40...	194.5	51.5	23.0
+10...	187.654	23.778	6.047	41...	192.98	54.0	24.62
15...	189.25	27.0	7.25	41.7.	192.80	54.9	25.7
25...	193.89	34.0	10.11	45...	190.65	63.0	31.0
25.65	193.68	34.69	11.15	50...	184.06	78.13	42.40
26...	193.0	35.0	11.5	55...	170.22	98.42	60.37
30...	195.0	38.5	13.0	55.7.	168.28	101.28	62.84*

(*) Na₂SO₄ also in Solid Phase.

The authors also give results for the solubility of the individual salts in water at the above temperatures, and for mixtures of ammonium and sodium sulfates with the double salt $(\text{NH}_4)\text{NaSO}_4$. Determinations of the transformation temperatures in the above system are given by Sborgi and Stefanini, 1924.

Br AMMONIUM BROMIDE NH₄Br.

SOLUBILITY IN WATER.

(Smith and Eastlack, 1916.)

(Determinations by sealed tube method.)

t°.	Gms. NH ₄ Br per 100 Gms. H ₂ O.	t°.	Gms. NH ₄ Br per 100 Gms. H ₂ O.	t°.	Gms. NH ₄ Br per 100 Gms. H ₂ O.
-17 Eutec.	47.3	60	107.8	130	180
0	60.6	70	116.8	137.3	Transition pt.
10	68	80	126	140	192.3
20	75.5	90	135.6	150	202.5
30	83.2	100	145.6	160	213.4
40	91.1	110	156.5	170	225.5
50	99.2	120	167.8		

More recent determinations by Benrath and Schiffers, 1938, and Benrath Gjedebø, Schiffers and Wunderlich, 1937, gave the following results.

t°	Gms. NH ₄ Br per 100 gms. sat. sol.	t°	Gms. NH ₄ Br per 100 gms. sat. sol.	t°	Gms. NH ₄ Br per 100 gms. sat. sol.
0	37.3	70	52.8	200	71.5
10	40.0	80	54.4	225	74.2
20	42.6	90	56.0	250	76.5
25	43.9	100	57.4	275	78.2
30	45.0	120	61.5	300	81.0
40	47.3	140	64.5	350	84.5
50	49.4	160	67.0	400	87.5
60	51.2	180	69.5	480	91.5

SOLUBILITY OF AMMONIUM BROMIDE IN AQUEOUS SOLUTIONS
OF HYDROBROMIC ACID AT 25° .

(Scott and Durham, 1930.)

Gms. per 100 gms. sat. solution	
HBr	NH_4Br
0.0	43.86
12.53	27.91
16.94	24.06
22.72	15.96

SOLUBILITY OF AMMONIUM BROMIDE IN AQUEOUS SOLUTIONS OF
LEAD BROMIDE AT 25° AND VICE VERSA.

(Wilkerson, Bathurst and Parton, 1937.)

per 100 gms. H_2O		Solid Phase	Gms. per 100 gms. H_2O		Solid Phase
NH_4Br			PbBr_2	NH_4Br	
0	79.39	NH_4Br	1.38	32.13	$\text{NH}_4\text{Br} \cdot 2\text{PbBr}_2$
3	82.56	"	0.392	19.26	"
93	84.37	"	0.232	13.58	"
26	88.80	" + $2\text{NH}_4\text{Br} \cdot \text{PbBr}_2$	0.155	6.688	"
89	81.87	$2\text{NH}_4\text{Br} \cdot \text{PbBr}_2$	0.155	5.607	"
07	76.07	"	0.173	4.239	"
99	69.90	"	0.200	3.398	" + PbBr_2
17	63.53	"	0.244	2.066	PbBr_2
87	61.44	" + $\text{NH}_4\text{Br} \cdot 2\text{PbBr}_2$	0.273	1.444	"
49	60.75	$\text{NH}_4\text{Br} \cdot 2\text{PbBr}_2$	0.572	0.395	"
845	50.03	"	0.981	0.00	"

Br

AMMONIUM Cadmium BROMIDE $(\text{NH}_4)_2\text{CdBr}_4 \cdot \frac{1}{2}\text{H}_2\text{O}$.

o parts water dissolve 137 parts of the salt; 100 parts of alcohol dissolve
parts and 100 parts of ether dissolve 0.36 part. (Eder, 1876.)

AMMONIUM Platinum BROMIDE $(\text{NH}_4)_2\text{PtBr}_6$.

o gms. sat. aqueous solution contain 0.59 gm. salt at 20° . (Halberstadt, 1884.)

AMMONIUM Platinum BROMIDE $(\text{NH}_4)_2\text{PtBr}_6$.

SOLUBILITY IN WATER. (Archibald and Kern, 1917.)

t°.	Gms. $(\text{NH}_4)_2\text{PtBr}_6$ per 100 gms. H_2O .	t°.	Gms. $(\text{NH}_4)_2\text{PtBr}_6$ per 100 gms. H_2O .	t°.	Gms. $(\text{NH}_4)_2\text{PtBr}_6$ per 100 gms. H_2O .
0.2.....	0.4165	29.7.....	0.8147	70.0.....	1.9265
7.3.....	0.5002	40.0.....	1.0355	80.0.....	2.3003
19.0.....	0.6438	50.0.....	1.2087	90.0.....	2.8470
25.0.....	0.7381	60.0.....	1.5780	99.0.....	3.5866

SOLUBILITY IN AQUEOUS SOLUTIONS OF AMMONIUM BROMIDE AT 20° .
(Archibald and Kern, 1917.)

Gms. mols. NH_4Br per liter.	Gms. $(\text{NH}_4)_2\text{PtBr}_6$ per 100 gms. solvent.
0.10	0.0179
0.20	0.0168
1.00	0.0080
2.00	0.0032

AMMONIUM Tin BROMIDES Mono = $\text{NH}_4\text{SnBr}_3 \cdot \text{H}_2\text{O}$; Di = $(\text{NH}_4)_2\text{SnBr}_4 \cdot \text{H}_2\text{O}$;
Tetra = $(\text{NH}_4)_4\text{SnBr}_6 \cdot \text{H}_2\text{O}$.

SOLUBILITY OF STANNOUS MONO AMMONIUM BROMIDE IN WATER.
(Rimbach and Fleck, 1916.)

t°.	Gms. per 100 gms. sat. sol.			Solid Phase.
	Br.	Sn.	NH ₄ .	
0.1....	15.16	4.95	1.91	$\text{NH}_4\text{SnBr}_3 \cdot \text{H}_2\text{O} + \text{SnBr}_2 \cdot \text{H}_2\text{O}$
17.7....	19.23	7.03	2.29	" "
36.8....	26.73	11.51	2.54	" "
56.7....	40.84 + 20.30	+	3.06 = 64.2 gms.	$\text{NH}_4\text{SnBr}_3 \cdot \text{H}_2\text{O}$
74.6....	49.43 + 25.56	+	3.71 = 77.7 gms.	"

At temperatures below 56° the atomic ratios of Br : Sn : NH₄ did not correspond to the double salt hence in these cases the solid phase was a mixture of the double salt and stannous bromide.

SOLUBILITY OF STANNOUS DIAMMONIUM BROMIDE IN WATER
(Rimbach and Fleck, 1916.)

t°.	Gms. per 100 gms. sat. sol.			Solid Phase.
	Br.	Sn.	NH ₄ .	
0.2.....	21.57	1.99	4.26	$(\text{NH}_4)_2\text{SnBr}_4 \cdot \text{H}_2\text{O} + \text{SnBr}_2 \cdot \text{H}_2\text{O}$
14.4.....	26.65	4.49	4.65	" "
36.6.....	38.87	10.19	5.69	" "
60.6.....	48.70	16.01	6.13	" "
80.5.....	52.21 + 19.36	+	5.91 = 77.4 gms.	$(\text{NH}_4)_2\text{SnBr}_4 \cdot \text{H}_2\text{O}$

The ratio of Br : Sn : NH₄ in solution, corresponding to the double salt, was reached only at temperatures above 60°.

SOLUBILITY OF STANNOUS TETRA AMMONIUM BROMIDE IN WATER.
(Rimbach and Fleck, 1916.)

t°.	Gms. per 100 gms. sat. sol.			Solid Phase.
	Br.	Sn.	NH ₄ .	
1.8.....	30.33	0.65	6.65	$(\text{NH}_4)_4\text{SnBr}_6 \cdot \text{H}_2\text{O} + \text{SnBr}_2 \cdot \text{H}_2\text{O}$
16.0.....	34.62	2.00	7.21	" "
73.3.....	52.52	10.37	8.71	" "
91.6.....	56.66	13.53	8.68	" "

The atomic ratio Br : Sn : NH₄ corresponding to the double salt was not reached below 91°.

SOLUBILITY OF AMMONIUM BROMIDE IN ABSOLUTE ETHYL ALCOHOL, METHYL ALCOHOL, AND IN ETHER.
(Eder; de Bruyn — Z. phys. Ch. 10, 783, '92.)

t°.	In Ethyl Alcohol. Gms. NH ₄ Br per 100 Grams.		In Methyl Alcohol. Gms. NH ₄ Br per 100 Grams.		In Ether (0.720 Sp. Gr.). Gms. NH ₄ Br per 100 Grams.
	Solution.	Alcohol.	Solution.	Alcohol.	Ether.
15	2.97	3.06	....	....	0.123
19	3.12	3.22	11.1	12.5	....
78	9.50	10.50	....	....	....

100 cc. ethyl alcohol of $d_{16} = 0.8352$ dissolve 7.8 grams NH₄Br at 15°, d_{16} of sat. sol. = 0.8848. (Greenish, 1900.)

100 cc. anhydrous hydrazine dissolve 110 gms. NH₄Br at room temp. with evolution of ammonia. (Welsh and Broderson, 1915.)

100 gms. glycerol of $d_{20} = 1.2326$ dissolve 31.9 gms. NH₄Br at 20°. (Holm, 1922.)
" 1.2645 " 27.2 " "

SOLUBILITY OF AMMONIUM BROMIDE AT 25° IN MIXTURES OF:
(Herz and Kuhn, 1908.)

Methyl and Ethyl Alcohols.			Propyl and Methyl Alcohols.			Propyl and Ethyl Alcohols.		
Gms. OH per 100 Gms. Solvent.	d 20° of Sat. Sol.	Gms. NH_4Br per 100 cc. Sat. Sol.	Gms. $\text{C}_2\text{H}_5\text{OH}$ per 100 Gms. Solvent.	d 20° of Sat. Sol.	Gms. NH_4Br per 100 cc. Sat. Sol.	Gms. $\text{C}_2\text{H}_5\text{OH}$ per 100 Gms. Solvent.	d 20° of Sat. Sol.	Gms. NH_4Br per 100 cc. Sat. Sol.
0	0.8065	2.55	0	0.8605	9.83	0	0.8065	2.55
4.37	0.8083	2.99	11.11	0.8524	8.51	8.51	0.8062	2.51
10.40	0.8117	3.21	23.8	0.8426	6.90	17.85	0.8052	2.37
18.02	0.8252	5.06	65.2	0.8184	3.08	50.0	0.8048	1.63
25.69	0.8501	8.13	91.8	0.8097	1.28	88.6	0.8042	1.11
34.77	0.8508	8.47	93.75	0.8089	1.25	91.2	0.8040	1.05
41.25	0.8551	9.34	100	0.8059	0.95	95.2	0.8050	1.04
50	0.8605	9.83				100	0.8050	0.95

Tetra Ethyl AMMONIUM BROMIDE $\text{N}(\text{C}_2\text{H}_5)_4\text{Br}$

SOLUBILITY OF TETRA ETHYL AMMONIUM BROMIDE IN SEVERAL SOLVENTS.
(Bjerrum and Josefowicz, 1932.)

Br

Solvent	Formula	t°	d. of sat. sol.	(Gms. $\text{N}(\text{C}_2\text{H}_5)_4\text{Br}$ per 100 gms. sat. sol.)
Water	H_2O	20	1.193	75.5
"	"	35	1.1935	76.7
Ethyl Alcohol	CH_3OH	20	1.0225	58.3
"	"	35	1.0315	61.5
Ethyl Alcohol	$\text{C}_2\text{H}_5\text{OH}$	20	0.9151	34.6
"	"	35	0.9288	40.9
Acetone	$(\text{CH}_3)_2\text{CO}$	20	0.7993	0.193
"	"	35	0.7740	0.252

SOLUBILITY OF TETRA ETHYL AMMONIUM BROMIDE $\text{N}(\text{C}_2\text{H}_5)_4\text{Br}$, AND OF
TETRA METHYL AMMONIUM BROMIDE $\text{N}(\text{CH}_3)_4\text{Br}$ IN ACETONITRILE.
(Walden -- Z. phys. Ch., 55, 712, 1906.)

100 cc. sat. solution in CH_3CN contain 9.59 gms. $\text{N}(\text{C}_2\text{H}_5)_4\text{Br}$ at 25°.
100 cc. sat. solution in CH_3CN contain 0.17 gm. $\text{N}(\text{CH}_3)_4\text{Br}$ at 25°.

SOLUBILITY OF TETRA ETHYL AMMONIUM BROMIDE IN WATER AND
IN CHLOROFORM AT 25°.

(Peddle and Turner, 1911.)

100 gms. H_2O dissolve 279.5 gms. $\text{N}(\text{C}_2\text{H}_5)_4\text{Br}$.
100 gms. CHCl_3 dissolve 25.01 gms. $\text{N}(\text{C}_2\text{H}_5)_4\text{Br}$.

Data for the distribution of propyl benzyl methyl phenyl AMMONIUM BROMIDE between water and chloroform at 25° are given by Wedekind and Maschke (1910).

Tetra methylAMMONIUM BROMIDE $(\text{CH}_3)_4\text{NBr}$.

100 cc. pure Ethyl urethan dissolve 0.22 gm. $(\text{CH}_3)_4\text{NBr}$ at 60° . (Stueckgold, 1917.)

PerhaloidAMMONIUM BROMIDES, etc.

SOLUBILITY OF EACH IN ACETIC ACID AT 38° .

(Mc Combie and Reado, 1923.)

Compound.	Formula.	Gms. compd. per liter.
Phenyl trimethyl Ammonium Bromide Di Chloride...	$\text{N}(\text{C}_6\text{H}_5)(\text{CH}_3)_3\text{BrCl}_2$	50.0
" " " " Di Bromide...	$\text{N}(\text{C}_6\text{H}_5)(\text{CH}_3)_3\text{BrBr}_2$	8.0
" " " " Di Iodide....	$\text{N}(\text{C}_6\text{H}_5)(\text{CH}_3)_3\text{BrI}_2$	6.5
" " " " Iodo Bromide.	$\text{N}(\text{C}_6\text{H}_5)(\text{CH}_3)_3\text{BrIBr}$	6.6
" " " Chloride Iodo Chloride.	$\text{N}(\text{C}_6\text{H}_5)(\text{CH}_3)_3\text{ClCl}$	13.3
" " " Iodide Iodo Iodide...	$\text{N}(\text{C}_6\text{H}_5)(\text{CH}_3)_3\text{I}_2$	1.6

SOLUBILITY OF AMMONIUM POLYHALIDES IN WATER AND IN CARBON TETRACHLORIDE AT 25° .

(Cramer and Duncan, 1931.)

Compound	Gm. Mols. Compd. (1) per liter CCl_4	Gms. Compd. per 100 gms. sat. sol. in H_2O
NH_4IBr_2	0.0084	Very soluble
$\text{C}_3\text{H}_7(\text{a})\text{NH}_3\text{IBr}_2$	0.0076	" "
$\text{C}_3\text{H}_7(\text{b})\text{NH}_3\text{IBr}_2$	0.0025	" "
$\text{C}_2\text{H}_5\text{NH}_2\text{IBr}_2$	0.0066	Readily soluble
$(\text{CH}_3)_3\text{NHIBr}_2$	0.0025	Moderately soluble
$\text{CH}_3\text{NH}_3\text{IBr}_2$	0.0013	" "
$(\text{C}_2\text{H}_5)_2\text{NH}_2\text{IBr}_2$	0.0012	" "
$\text{C}_6\text{H}_5\text{N}(\text{CH}_3)\text{IBr}_2$	0.00023	1.33
$\text{C}_6\text{H}_5\text{NHIBr}_2$	0.00018	1.27
$(\text{CH}_3)_2\text{NH}_2\text{IBr}_2$	0.00004	3.0 at 0°
$(\text{CH}_3)_4\text{NIBr}_2$	0.00004	0.85
$(\text{CH}_3)_3\text{N}(\text{C}_2\text{H}_5)\text{IBr}_2$	0.00002	0.60
$(\text{C}_2\text{H}_5)_4\text{NIBr}_2$	0.00000	0.25

(1) The authors fail to state the terms in which their results for CCl_4 are expressed.

SOLUBILITY OF AMMONIUM BROMIDE IN LIQUID AMMONIA.

t°	Gms. NH_4Br per 100 gms. NH_3	cc sat. sol. in NH_3	t°	Gms. NH_4Br per 100 gms. NH_3	cc sat. sol. in NH_3
-50	—	47.1 (1)	-38.2	—	50.6 (1)
-44	—	48.2 (1)	-33.9	90.75	50.46 (d. = 1.0608) (2)
-41.2	—	48.9 (1)	-31.8	—	52.0 (1)
-42.8	—	49.0 (1)	0	137.9	— (3)
-40.5	—	49.7 (1)	25	237.9	— (4)

(1) Scherer, 1931; (2) Johnson and Krumboltz, 1933; (3) Linhard and Stephan, 1933, 1934; (4) Hunt, 1932.

100 gms. liquid Sulfur Dioxide dissolve 0.059 gm. NH_4Br at 0° . (Jander and Wickert, 1936, 1937.)

AMMONIUM FORMATE HCOONH_4 , and also Ammonium Acid Formate.SOLUBILITY IN WATER.
(Groschull - Ber. 36, 4351, '03.)

t°.	Gms. HCOONH_4 per 100 Gms.		Solid Phase.	t°.	Gms. per 100 Gms. Solution.		Solid Phase.
	Solution.	Water.			HCOONH_4 .	HCOOH .	
-20	41.9	72	HCOONH_4	-	6.5	46.7	34.1 HCOONH_4 HCOOH
0	50.5	102	"	+	1.5	49.6	36.2 "
20	58.9	143	"		6	51.3	37.4 "
40	67.1	204	"		8.5	52.1	38 "
60	75.7	311	"	-	7	49.6	36.2 HCOONH_4 labil.
80	84.2	531	"	+	13	53	38.6 " stabil.
116 m. pt.				20	55.8	40.7	" "
				39	57.8	42.2	H_2O free solution

SOLUBILITY OF AMMONIUM FORMATE IN FORMIC ACID SOLUTIONS.
(Groschull.)

30 grams of HCOONH_4 dissolved in weighed amounts of anhydrous formic acid and cooled to the point at which a solid phase separated.

t°.	Gms.		Solid Phase.	t°.	Gms.		Solid Phase.
	HCOONH_4 per 100 Gms. Solution.	G. M. HCOONH_4 per 100 G. M. HCOOH .			HCOONH_4 per 100 Gms. Solution.	G. M. HCOONH_4 per 100 G. M. HCOOH .	
-3	35.3	39.9	HCOONH_4	11	50	73	HCOONH_4 labil.
-8.5	40.6	49.9	"	39	57.8	100	" stabil.
21.5	50	73	"	78	73.1	100	" "
				116 m pt.	100	100	" "

100 gms. 95% Formic Acid dissolve 6.2 gms. HCOONH_4 at 21°. (Achan, 1911)

CH

Freezing-point data for mixtures of $\text{NH}_4\text{HCOO} + \text{HCOOH}$ are given by Kendall and Adler, 1921.

AMMONIUM METHIONATE $(\text{NH}_4)_2\text{CH}_2\text{O}_6\text{S}_2$.

100 gms. H_2O dissolve 32.01 gm. $(\text{NH}_4)_2\text{CH}_2\text{O}_6\text{S}_2$ at 25°. (Backer and Terpstra, 1929.)

AMMONIUM ACETATE $\text{CH}_3\text{COONH}_4$.

SOLUBILITY IN AQUEOUS SOLUTIONS OF ACETIC ACID. (Suggen, 1926)

t°	Gms. per 100 gms sat. sol.		Solid Phase.	t°.	Gms. per 100 gms. sat. sol.		Solid Phase.
	CH_3COOH .	$\text{CH}_3\text{COONH}_4$.			CH_3COOH .	$\text{CH}_3\text{COONH}_4$.	
0...	3.7	63.8	$\text{CH}_3\text{COONH}_4$	16...	38.1	42.5	$\text{CH}_3\text{COONH}_4$, CH_3COOH
0...	15.8	61.1*	"	16...	37.3	42.6	"
0...	19.6	48.9	$\text{CH}_3\text{COONH}_4$, CH_3COOH	16...	37.3	27.3	"
0...	61.6	28.1	"	25...	24.15	20.6	$\text{CH}_3\text{COONH}_4$
16...	0.91	67.8	$\text{CH}_3\text{COONH}_4$	25...	12.0	67.0	"
16...	7.73	64.4	"	25...	21.1	63.4	"
16...	16.0	62.6	"	25...	31.3	58.9*	"
16...	19.7	61.1*	"	25...	24.2	60.2	$\text{CH}_3\text{COONH}_4$, CH_3COOH
16...	23.9	59.6*	"	25...	36.2	48.5	"
16...	17.1	61.1	$\text{CH}_3\text{COONH}_4$, CH_3COOH	25...	47.6	41.0	"
16...	21.7	55.6	"	25...	39.9	44.2	"
16...	22.7	54.3	"				

* Indicates unstable equilibrium.

AMMONIUM Phenoxy**ACETATE**.**AMMONIUM** *o* Iodo**BENZOATE**, etc.

SOLUBILITY OF EACH IN WATER, METHYL ALCOHOL AND IN ETHYLALCOHOL AT 26°.
(Mc Master and Pratte, 1922.)

	Salt.	Formula.	Gms. salt p r 100 gms.		
			Water.	CH ₃ OH.	C ₂ H ₅ OH.
Ammonium	Phenoxyacetate	C ₆ H ₅ O.CH ₃ COONH ₄	13.03	3.97	0.44
"	<i>p</i> Nitrophenylacetate	<i>p</i> NO ₂ .C ₆ H ₄ CH ₂ .COONH ₄ ...	7.41	15.14	1.82
"	<i>o</i> Iodo Benzoate	<i>o</i> I.C ₆ H ₄ (COONH ₄).....	67.11	184.10	63.37
"	<i>o</i> Methoxy "	<i>o</i> CH ₃ O.C ₆ H ₄ .COONH ₄	38.25	17.85	4.82
"	1,2,4 Dinitro "	1,2,4 (NO ₂) ₃ C ₆ H ₃ COONH ₄	62.70	21.39	3.85
"	2,5 DichlorobenzeneSulfonate	C ₆ H ₃ Cl ₂ .SO ₃ .NH ₄	11.30	20.15	2.59
"	4 Nitrochlorobenzene-2-Sulfonate	C ₆ H ₄ .NO ₂ .ClSO ₃ NH ₄	4.72	2.76	0.96

AMMONIUM ACETATE

EQUILIBRIUM IN THE SYSTEM AMMONIUM ACETATE AND ACETIC ACID
DETERMINED BY THE FREEZING-POINT METHOD.

(Davidson and McAllister, 1930.)

CH

t°	Mol. Percen: NH ₄ C ₂ H ₃ O ₂	Solid Phase	t°	Mol. Percent NH ₄ C ₂ H ₃ O ₂	Solid Phase
16.5	0.0	HC ₂ H ₃ O ₂	56.4	34.95	NH ₄ C ₂ H ₃ O ₂ .HC ₂ H ₃ O ₂
14.2	4.64	"	63.0	40.80	"
10.45	9.35	"	65.5	45.05	"
6.90	12.03	"	66.0	47.66	"
2.8	14.54	"	66.5m.pt.	50.00	"
-3.0	17.08	"	66.0	51.75	"
-6.5	18.54*	"	65.2	53.20	" + NH ₄ C ₂ H ₃ O ₂
2.5	19.43	NH ₄ C ₂ H ₃ O ₂ .HC ₂ H ₃ O ₂	68.5	54.83	NH ₄ C ₂ H ₃ O ₂
9.6	20.67	"	75.7	58.70	"
24.0	23.15	"	93.0	69.50	"
40.1	27.06	"	102.0	76.84	"
50.1	31.10	"	113.0	100.00	"

Data for equilibrium in the System Ammonium Acetate + Nickel Acetate + Acetic Acid at 30° are given by Davidson and Chappell, 1933.

100 gms. Liquid Ammonia (NH₃) dissolve 253.16(?) gms. NH₄C₂H₃O₂ at 25°. (Hunt and Boncyk, 1933.)

100 gms. Liquid Sulfur Dioxide (SO₂) dissolve 1.09 gm. NH₄C₂H₃O₂ at 0°. (Jander and Ruppolt, 1937.)

100 gms. Methyl Alcohol (CH₃OH) dissolve 7.89 gms. NH₄C₂H₃O₂ at 15° and 131.24 gms. at 94.2° (b.pt.). (Henstock, 1934.)

100 cc sat. solution of ammonium acetate in Acetone contain 0.27 gm. CH₃COONH₄ at 19°. (Roshdestwensky and Lewis, 1912.)

AMMONIUM TARTRATE (d) $(\text{NH}_4)_2\text{C}_4\text{H}_4\text{O}_6$.

SOLUBILITY OF AMMONIUM TARTRATE IN WATER.
(Timmermans and Dumont, 1931; Campbell and Slotin, 1933.)

The results of the above named investigators, although differing somewhat, especially at 20° and 30°, gave a curve from which the following values were read.

t°	Gms. $(\text{NH}_4)_2\text{C}_4\text{H}_4\text{O}_6$ per 100 gms. H_2O	Solid Phase	t°	Gms. $(\text{NH}_4)_2\text{C}_4\text{H}_4\text{O}_6$ per 100 gms. H_2O	Solid Phase
-7.6 Eutec.	40.0	Ice + $(\text{NH}_4)_2\text{C}_4\text{H}_4\text{O}_6$	25	67.0	$(\text{NH}_4)_2\text{C}_4\text{H}_4\text{O}_6$
0	45.0	$(\text{NH}_4)_2\text{C}_4\text{H}_4\text{O}_6$	30	70.5	"
10	55.0	"	40	76.5	"
15	59.5	"	50	81.5	"
20	63.0	"	60	87.0	"

AMMONIUM Acid TARTRATE (d) $(\text{NH}_4)\text{HC}_4\text{H}_4\text{O}_6$.

SOLUBILITY OF AMMONIUM ACID TARTRATE IN WATER.
AMMONIUM Acid TARTRATE (d) $(\text{NH}_4)\text{HC}_4\text{H}_4\text{O}_6$.

SOLUBILITY OF AMMONIUM ACID TARTRATE IN WATER.
(Timmermans and Dumont, 1931.)

t°	Gms. $\text{NH}_4\text{HC}_4\text{H}_4\text{O}_6$ per 100 gms. H_2O	Solid Phase
-0.3 Eutec.	1.0	Ice + $\text{NH}_4\text{HC}_4\text{H}_4\text{O}_6$
15	2.35	$\text{NH}_4\text{HC}_4\text{H}_4\text{O}_6$
20	2.70	"
25	3.24	"

Results for equilibrium in the following systems are also given by Timmermans and Dumont, 1931.

(d) Ammonium Acid Tartrate	+	(l) Ammonium Acid Malate	+	H_2O
(l) " "	+	(l) " "	+	" "
(d) " "	+	(d) " "	+	" chlor succinate + H_2O
(d) " "	+	(l) " "	+	" " + H_2O
(d) " Neutral	+	(d) " Neutral	+	" " + "
(l) " "	+	(d) " "	+	" " + "
(l) " Acid Malate	+	(l) " Acid	+	" " + "
(l) " " "	+	(d) " "	+	" " + "

AMMONIUM Acid MALATE (l) $\text{NH}_4\text{HC}_4\text{H}_4\text{O}_6$.

SOLUBILITY OF AMMONIUM ACID MALATE IN WATER.
(Timmermans and Dumont, 1931.)

t°	Gms. $\text{NH}_4\text{HC}_4\text{H}_4\text{O}_6$ per 100 gms. H_2O	Solid Phase
-4.0	30.0	(l) $\text{NH}_4\text{HC}_4\text{H}_4\text{O}_6$
+10	38.76	"
20	46.63	"
25	41.72	"

AMMONIUM SUCCINATE (NH₄)₂(CH₂)₂(COO)₂.

EQUILIBRIUM IN THE SYSTEM AMMONIUM SUCCINATE
AMMONIUM CHLORIDE AND WATER AT 25°.2.

(Linnarss., 1929.)

Ammonium succinate is designated as NH₄S in the paper and no indication given as to whether this represents the neutral or acid salt. The mixtures were shaken for about three weeks at 25.2°.

Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase
NH ₄ Cl	(NH ₄) ₂ (CH ₂) ₂ (COO) ₂ (?)		NH ₄ Cl	(NH ₄) ₂ (CH ₂) ₂ (COO) ₂ (?)	
0.0	50.74	(NH ₄) ₂ (CH ₂) ₂ (COO) ₂ (?)	10.75	41.67	NH ₄ Cl
7.62	44.34	"	15.00	29.49	"
10.63	42.15	"	22.24	12.74	"
			23.47	0.0	

100 gms. Methyl Alcohol, CH₃OH, dissolve 1.62 gms. Ammonium Succinate at 15° and 5.84 gms. at 66.6° (b.pt.).

100 gms. Acetone, (CH₃)₂CO, dissolve 0.47 gms. Ammonium Succinate at 15°. (Henstock, 1934.)

CH

AMMONIUM Chloro SUCCINATES (d) (NH₄)₂CH₂CHCl(COO)₂ NH₄HCH₂CHCl(COO)₂.

SOLUBILITY OF EACH IN WATER.

(Timmerman and Pammel, 1931.)

Results for the:

Neutral (d) Succinate

Acid (d) Succinate

t°	Gms. (NH ₄) ₂ CH ₂ CHCl(COO) ₂ per 100 gms. H ₂ O	Solid Phase	t°	Gms. NH ₄ HCH ₂ CHCl(COO) ₂ per 100 gms. H ₂ O	Solid Phase
- 8.8 (Eutec.)	33.0	Ice + (NH ₄) ₂ CH ₂ CHCl(COO) ₂	27.5	Ice + NH ₄ HCH ₂ CHCl(COO) ₂	
+15.0	61.30	(NH ₄) ₂ CH ₂ CHCl(COO) ₂	51.14	NH ₄ HCH ₂ CHCl(COO) ₂	
20.0	60.03	"			

AMMONIUM URATE (Primary) C₄H₄N₄O₃NH₂

SOLUBILITY OF THE LACTAM AND LACTIM FORMS IN WATER.

(Guenther, 1928-29.)

Gms. of Each per 100 cc. Sat. solution

t°	Lactam	Lactim	Mixture of the Two
18	0.450	0.104	0.414
37	0.817	0.546	0.741

AMMONIUM CITRATES.

SOLUBILITY IN AQUEOUS SOLUTIONS OF CITRIC ACID AT 30°.
(van Itallie, 1908.)

(Data read from curve plotted from original results.)

Gms. per 100 Gms. Sat. Sol.		Solid Phase.	Gms. per 100 Gms. Sat. Sol.		Solid Phase.
$C_6H_8O_7$.	NH_3 .		$C_6H_8O_7$.	NH_3 .	
65	0	$C_6H_8O_7 \cdot H_2O$	53	7.5	$C_6H_7O_7 \cdot NH_4$
68	0.5	"	56	8.2	"
72	1.3	"	59.1	8.5	$C_6H_7O_7 \cdot NH_4 + C_6H_8O_7 \cdot (NH_4)_2$
75	2.3	$C_6H_8O_7 \cdot H_2O + C_6H_7O_7 \cdot NH_4$	54	8.5	$C_6H_8O_7 \cdot (NH_4)_2$
70	2.4	$C_6H_7O_7 \cdot NH_4$	50	7.9	"
65	2.5	"	45.8	8.4	"
60	2.7	"	47	11.1	"
55	2.8	"	50	12.9	"
52	2.8	"	54.5	14.5	$C_6H_8O_7 \cdot (NH_4)_2 + C_6H_8O_7 \cdot (NH_4)_3 \cdot ?H_2O$
50	3.6	"	52	15	$C_6H_8O_7 \cdot (NH_4)_3 \cdot ?H_2O$
49.2	5.1	"	50	16	"
50	6.2	"	48.4	17.9	"

Composition of the solid phases determined by "Rest Method."

(Schreinemakers, Z. anorg. Ch. 37, 207.)

AMMONIUM PICRATE $C_6H_2(NO_2)_3ONH_4$.

100 cc. H_2O dissolve 1.1 gm. Am. picrate at room temp. (Squire and Caines, 1905.)

100 cc. 90% alcohol dissolve 1.2 gm. Am. picrate at room temp.

(Squire and Caines, 1905.)

AMMONIUM BENZOATE $C_6H_5COONH_4$.

SOLUBILITY IN WATER AND IN AQUEOUS ALCOHOL AT 25°.

(Seidell, 1910.)

Gms. C_2H_5OH per 100 Gms. Solvent.	d_{25} of Sat. Sol.	Gms. $C_6H_5COONH_4$ per 100 Gms. Sat. Sol.	Gms. C_2H_5OH per 100 Gms. Solvent	d_{25} of Sat. Sol.	Gms. $C_6H_5COONH_4$ per 100 Gms. Sat. Sol.
0	1.043	18.6	60	0.930	15
10	1.027	18	70	0.901	12.2
20	1.012	18	80	0.864	8.3
30	0.997	18.1	90	0.828	4.2
40	0.979	18	95	0.810	2.7
50	0.956	17	100	0.796	1.6

Results in good agreement with the above are given by Gregg, Wilson and Wright, 1928.

100 gms. water dissolve 19.6 gms. $C_6H_5COONH_4$ at 14° 5, d_{14} of sat. sol. = 1.042.

(Greenish and Smith, 1901.)

100 gms. water dissolve 83.33 gms. $C_6H_5COONH_4$ at b.-pt.

(U. S. P.)

100 gms. glycerol dissolve 10 gms. $C_6H_5COONH_4$ at room temp.

(Hager.)

100 gms. Methyl Alcohol CH_3OH , dissolve 6.39 gms. $NH_4C_6H_5COO$ at 15° and 13.07 gms. at 66° (b.pt.). A methyl alcoholate of the composition $NH_4(C_6H_5COO)_{1.12}CH_3OH$ was prepared from hot methyl alcohol. (Henstock, 1934.)

AMMONIUM SALICYLATE C₆H₄OH.COONH₄.

SOLUBILITY IN AQUEOUS ALCOHOL SOLUTIONS AT 25°.
(Seidell, 1909, 1910.)

Gms. C ₆ H ₅ OH per 100 Gms. Solvent	Sp. Gr. of Sat. Sol.	Gms. C ₆ H ₄ OH.COONH ₄ per 100 Gms. Sat. Sol.	Gms. C ₆ H ₅ OH per 100 Gms. Sat. Sol.	Sp. Gr. of Sat. Sol.	Gms. C ₆ H ₄ OH. COONH ₄ per 100 Gms. Sat. Sol.
0	1.148	50.8	70	1.015	42
20	1.122	50.3	80	0.979	38
40	1.088	48.3	90	0.936	31.6
50	1.067	46.7	95	0.907	27.8
60	1.042	44.7	100	0.875	22.3

Results in good agreement with the above are given by Gregg, Wilson and Wright, 1928.

100 gms. Methyl Alcohol, CH₃OH, dissolve 71.55 gms. NH₄C₆H₄OHCOO at 15° and 163.78 gms. at 72.8° (b.pt.). (Henstock 1934.)

SOLUBILITY OF AMMONIUM SALICYLATE IN ACETONE.
(Henstock, 1934.)

t°	Gms. NH ₄ C ₆ H ₄ OHCOO per 100 gms. CH ₃ COCH ₃	Solid Phase	t°	Gms. NH ₄ C ₆ H ₄ OHCOO per 100 gms. CH ₃ COCH ₃	Solid Phase
15	69.65	NH ₄ C ₆ H ₄ OHCOO	45	37	(?)
25	24.0	"	55	46	"
35	28.8	" (?)	65	67	"

CH

100 cc Ethyl Ether (U.S.P.) dissolve 0.67 gm. NH₄C₆H₄OHCOO at about 20°. (Bove, 1920.)

AMMONIUM NITROSALICYLATE, 5.2.1 NO₂C₆H₃(OH)(COONH₄).

AMMONIUM NAPHTHALENE SULFONATES α and β C₁₀H₇SO₃NH₄.

SOLUBILITY OF EACH IN WATER AND IN METHYL AND ETHYL ALCOHOLS AT 20°.
(Mc Master and Prattle, 1923, 1924.)

Compound.	Formula	Gms. compound per 100 gms.		
		H ₂ O	CH ₃ OH	C ₂ H ₅ OH
Ammonium Nitrosalicylate 5.2.1....	NO ₂ C ₆ H ₃ OHCOONH ₄	4.43	4.41	1.96
" α-Naphtalene sulfonate.	C ₁₀ H ₇ SO ₃ NH ₄	15.91	34.45	9.22
" β-Naphtalene sulfonate.	"	11.71	8.33	2.53

AMMONIUM GLUCONATE NH₄C₆H₁₁O₇.

100 cc sat. solution of Ammonium Gluconate in Water contain 29.9 gms. NH₄C₆H₁₁O₇ at 25°. (May, Weisberg and Herrick, 1929.)

AMMONIUM LAURATE C₁₁H₂₃COONH₄.

100 cc. of ethylene trichloride dissolve 0.23 gms. ammonium laurate at 0°, 0.57 gm. at 10° and 1.46 gm. at 20°. (Strahl, 1918, 1926.)

AMMONIUM Calcium MECONATE NH₄.CaC₇H₅O₇.2 H₂O.

1 liter of a saturated solution of ammonium calcium meconate in aqueous 0.1 N ammonia contains 1.2783 gm. NH₄CaC₇H₅O₇.2 H₂O at 18°.

(Heiduschka and Paul, 1917.)

AMMONIUM MANDELATE $\text{NH}_4\text{C}_6\text{H}_5\text{CHOHCOO}$ (dl) and (l).EQUILIBRIUM IN THE SYSTEM (dl) AMMONIUM MANDELATE, (dl) MANDELIC ACID AND WATER AT 25° .

(Ross and Morrison, 1936.)

Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase
$\text{C}_6\text{H}_5\text{CH.OHCOOH}$	$\text{NH}_4\text{C}_6\text{H}_5\text{CHOHCOO}$		$\text{C}_6\text{H}_5\text{CHOHCOOH}$	$\text{NH}_4\text{C}_6\text{H}_5\text{CHOHCOO}$	
17.02	56.2	1.1	50.5	27.4	1.3
20.7	50.9	"	50.9	26.3	" + $\text{C}_6\text{H}_5\text{CHOHCOOH}$
25.4	45.7	"	51.2	25.4	$\text{C}_6\text{H}_5\text{CHOHCOOH}$
28.3	42.1	"	50.8	24.5	"
35.2	36.1	"	47.9	19.8	"
41.1	33.9	"	44.2	15.9	"
47.2	32.2	"	31.1	8.9	"
47.0	32.3	1.3	22.7	4.5	"
49.7	28.7	"	16.95	0.0	"

1.1 = $\text{NH}_4\text{C}_6\text{H}_5\text{CHOHCOO} \cdot \text{C}_6\text{H}_5\text{CHOHCOOH}$; 1.3 = $\text{NH}_4\text{C}_6\text{H}_5\text{CHOHCOO} \cdot 3\text{C}_6\text{H}_5\text{CHOHCOOH}$.EQUILIBRIUM IN THE SYSTEM (l) AMMONIUM MANDELATE, (l) MANDELIC ACID AND WATER AT 25° .

(Ross, Morrison and Johnstone, 1937.)

Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase
$\text{C}_6\text{H}_5\text{CHOHCOOH}$	$\text{NH}_4\text{C}_6\text{H}_5\text{CHOHCOO}$		$\text{C}_6\text{H}_5\text{CHOHCOOH}$	$\text{NH}_4\text{C}_6\text{H}_5\text{CHOHCOO}$	
18.7	61.5	1.1	47.2	35.4	$\text{C}_6\text{H}_5\text{CHOHCOOH}$
22.2	55.5	"	46.5	34.0	"
24.7	51.9	"	45.8	30.6	"
29.0	48.0	"	39.1	25.9	"
37.0	42.6	"	31.1	19.5	"
43.9	36.4	"	18.8	13.1	"
46.9	36.0	$\text{C}_6\text{H}_5\text{CHOHCOOH}$	12.9	7.8	"
			10.1	0.0	"

1.1 = $\text{NH}_4\text{C}_6\text{H}_5\text{CHOHCOO} \cdot \text{C}_6\text{H}_5\text{CHOHCOOH}$.AMMONIUM β -Naphthalene Mono SULFONATE $\text{C}_{10}\text{H}_7\text{SO}_3\text{NH}_4$.100 cc. of the saturated aqueous solution contain 13.05 gms. of the salt at 25° , and $d_{25} = 1.034$. (Witt, 1915.)AMMONIUM Phenanthrene Mono SULFONATES $\text{C}_{14}\text{H}_9\text{SO}_3\text{NH}_4$ (2), (3) and (10).SOLUBILITY IN WATER AT 20° .

(Sandquist, 1912.)

100 gms. H_2O dissolve 0.37 gms. $\text{C}_{14}\text{H}_9\text{SO}_3\text{NH}_4$ (2).100 gms. H_2O dissolve 0.26 gms. $\text{C}_{14}\text{H}_9\text{SO}_3\text{NH}_4$ (3).100 gms. H_2O dissolve 4.41 gms. $\text{C}_{14}\text{H}_9\text{SO}_3\text{NH}_4$ (10).AMMONIUM 2,5 di-iodobenzene SULFONATE $\text{C}_6\text{H}_3\text{I}_2\text{SO}_3(\text{NH}_4)$.100 gms. H_2O dissolve 4.35 gms. salt at 20° .

(Boyle, 1909.)

AMMONIUM Anthraquinone Di SULFONATES

SOLUBILITY OF EACH SEPARATELY IN WATER.

(Fierz-David, Krebber and Anderson, 1977.)

Compound	Formula	ζ^0	Obs. Compound per 100 cc H_2O
Ammonium:			
Antraquinone 1.5 Disulfonate	$(NH_4)_2C_{14}H_6O_2(SO_3)_2$	18	2.27
"	"	100	7.70
" 1.8	$(NH_4)_2C_{14}H_6O_2(SO_3)_2 \cdot 2H_2O$	18	1.00
"	"	100	14.3
" 1.6	$(NH_4)_2C_{14}H_6O_2(SO_3)_2$	18	5.26
"	"	100	33.3
" 1.7	$(NH_4)_2C_{14}H_6O_2(SO_3)_2 \cdot 2H_2O$	18	8.33
"	"	100	50.00

The results are given in terms of cc H_2O to dissolve 1.0 gm. (anhydrous or hydrated ?) compound.

AMMONIUM N-Phenylβ AminoethylHydrogen Sulfate $C_6H_5NH.C_2H_4.O.SO_3.NH_4$
(m. pt. 133°)

100 cc. sat. solution in water contain 70 gms. of the salt at 15°. [Saunders, 1922.]

AMMONIUM 10-Chlorophenanthrene 3 or 6 Sulfonate $C_{14}H_9Cl \cdot SO_3NH_4 \cdot H_2O$.
100 gms. H_2O dissolve 0.44 gms. of the anhydrous salt at about 20°. (Sandqvist, 1917,

AMMONIUM Naphthylamine Disulfonates $\alpha, 6, 8$ and $\beta, 5, 7$, $C_{10}H_7NH_2 \cdot SO_3NH_4$.
100 gms. sat. solution in water contain 50.75 gms. of the $\alpha, 6, 8$ salt at 15°.

(Braunshweig, 1922, 1926.)

AMMONIUM HELIANTHATE $C_{14}H_{19}N_3SO_4 \cdot NH_4 \cdot 2H_2O$.

1000 cc. of water saturated at 20°-25° with respect to ammonium helianthate contain 6.0 gms. $C_{11}H_{11}N_3SO_4 \cdot NH_4 \cdot H_2O$. (Stark and Dehn, 1918.)

(Stark and Behn, 1918.)

AMMONIUM PALMITATE $(C_{16}H_{33}O_2)NH_4$

SOLUBILITY IN SEVERAL SOLVENTS.

(1) \mathcal{A} is a \mathcal{B} -algebra

$$(\text{C}_6\text{H}_5)_3\text{C}(\text{CH}_2)_3\text{N}^+\text{H}_3\text{I}^-$$
 and 100 g. of

t°.	Absolute Alcohol.	75% Alcohol	50% Alcohol	Mixture of 1 Pt. Alcohol to 2 Parts Ether	Acetone.
0	0.5	...	...	...	...
10	0.7	1.78	...	0.37 (13°)	0.2 (13°)
20	1.4	4.33	5.33	0.20	...
30	...	11.02	...	...	...
40	4.5	14.84	6.60	...	...
50	11	...	...	...	...

AMMONIUM OLEATE $C_{17}H_{33}COONH_4$.

SOLUBILITY IN SEVERAL SOLVENTS.

(Palomares, 1998)

Solvent.

Gms. $C_{27}H_{51}OONH$, dissolved per 100 cc. solvent:

Absolute Alcohol

31 at 0° 59 at 10° 100 at 50°

75 per cent Alcohol

... 8.2 at 20° 10.80 at 30°

1 part Alcohol + 2 parts Ether

... 0.45 at 15° 16.9 at 20°

Acetone

... 4.7 at 15" ...

AMMONIUM STEARATE $C_{18}H_{35}O_2NH_4$.SOLUBILITY IN SEVERAL SOLVENTS.
(Falcicola, 1910.)

t°.	Gms. $C_{18}H_{35}O_2NH_4$ per 100 cc. of:				
	Absolute Alcohol.	75% Alcohol.	50% Alcohol.	Ether.	Acetone.
0	0.1	...	...	...	...
10	0.3	0.56	0.25	...	0.08 (13°)
20	0.5	...	0.51	0.1	...
30	0.9	1.83	1.16	...	...
40	1.8	5	3.21	...	...
50	5.5	...	...	...	...

100 cc Ethylene Trichloride dissolve 0.04 gm. Ammonium Stearate at 0°, 0.12 gm. at 10° and 0.31 gm. at 20°. (Strauli, 1918, 1926.).

AMMONIUM Lead COBALTICYANIDE $NH_4PbCo(CN)_6 \cdot 3H_2O$.

(Schuler — Sitz. Ber. K. Akad. W. (Berlin) 79, 302.)

100 grams H_2O dissolve 12 grams of the salt at 18°.

CNS

AMMONIUM THIOCYANATE NH_4SCN

SOLUBILITY IN WATER.

(Average curve from results of Rüdorff, 1868 and 1872; Wassilijew, 1910; Smits and Kettner, 1912.)

t°.	Gms. NH_4SCN per 100 Gms. Sat. Sol.	Solid Phase.	t°.	Gms. NH_4SCN per 100 Gms. Sat. Sol.	Solid Phase.
-10	20	Ice	0	54.5	NH_4SCN
-15	28.5	"	+10	59	"
-20	35.5	"	20	63	"
-25.2	42 Eutec.	Ice + NH_4SCN	25	65.5	"
-10	50	NH_4SCN	30	67.5	"

More recent determinations with Solubility of Ammonium Thiocyanate in water by Shnidman, 1934, made by the synthetic method, gave the following results.

t°	Gms. NH_4SCN per 100 gms. sat. sol.	Solid Phase	t°	Gms. NH_4SCN per 100 gms. sat. sol.	Solid Phase
13.0	59.57	NH_4SCN	51.37	74.53	NH_4SCN
18.99	62.20	"	52.50	74.94	"
26.33	64.95	"	57.23	76.63	"
28.82	65.93	"	62.46	78.53	"
36.36	68.86	"	67.21	80.18	"
39.44	70.05	"	71.53	81.73	"
46.92	72.86	"			

Freezing-point data for mixtures of Ammonium Thiocyanate and water are given by Vasiliev, 1917.

SOLUBILITY OF AMMONIUM THIOCYANATE IN AQUEOUS SOLUTIONS OF AMMONIA
(Foote, 1921.)

t° = 10°.		t° = 20°.		t° = 30°.		Solid Phase in all cases. NH ₄ CNS
Gms. per 100 gms. sat. sol.		Gms. per 100 gms. sat. sol.		Gms. per 100 gms. sat. sol.		
NH ₃ .	NH ₄ CNS.	NH ₃ .	NH ₄ CNS.	NH ₃ .	NH ₄ CNS.	
0.0	58.23	0.0	62.54	0.0	66.26	
3.49	59.40	3.53	63.57	2.85	67.28	»
6.86	61.03	6.23	64.99	5.79	68.30	»
9.22	62.61	8.57	66.20	8.38	69.48	»
12.33	65.29	11.19	67.57	12.18	71.84	»
14.53	66.67	12.54	69.06	14.46	74.00	»
17.12	69.50	15.65	71.89	17.04	76.63	»
19.78	72.84	18.07	74.15	20.01	79.99	»
22.70	77.30	21.35	78.65			

Data for the system ammonium thiocyanate, thiourea and water at 25° are given by Smits and Kettner (1912) in the form of a triangular diagram, but the numerical results are omitted. The diagram confirms the freezing-point lowering results in showing that the molecular compound NH₄SCN.4(NH₂)₂CS is formed.

100 gms. acetonitrile dissolve 7.52 gms. NH₄SCN at 18°. (Naumann and Schier, 1914.)

CNS

Data for the system ammonium thiocyanate, ethyl ether and water at 20° are given by Nesterow and Petine, 1931.

SOLUBILITY OF AMMONIUM THIOCYANATE IN METHYL AND IN
ETHYL ALCOHOL, DETERMINED BY THE SYNTHETIC METHOD.
(Shaidman, 1934.)

Results for Methyl Alcohol		Results for Ethyl Alcohol	
t°	Gms. NH ₄ SCN per 100 gms. sat. solution	t°	Gms. NH ₄ SCN per 100 gms. sat. solution
24.58	37.11	18.45	19.07
32.94	40.05	33.25	21.54
44.80	44.70	36.93	22.16
54.76	49.30	43.36	23.46
64.55	54.55	57.62	26.72
		64.20	28.63

100 gms. Liquid Ammonia (NH₃) dissolve 312.0 gms. NH₄SCN at 25°.
(Hunt, 1932.)

100 gms. Liquid Sulfur Dioxide (SO₂) dissolve 46.8 gms. NH₄SCN at 0°.
(Jander and Ruppolt, 1937.)

Freezing-point data are given for:

Ammonium Thiocyanate + Ammonia (Bradley and Alexander, 1912.)
" " + Potassium Thiocyanate (Wrzesnewsky, 1912.)
" " + Thiocarbamide (Thiourea) (Renolds and Werner, 1903; Findlay, 1904; Atkins and Werner, 1912; Smits and Kettner, 1913; Wrzesnewsky, 1912; Kettner, 1919.)

AMMONIUM Bi CARBONATE NH₄HCO₃.

SOLUBILITY OF AMMONIUM BICARBONATE IN WATER.

(Jänecke, 1929.)

The usual method of solubility determination could not be employed since the vapor with which the solutions are in equilibrium is not that of H₂O alone or of CO₂ and NH₃ in the molecular ratio of ammonium bicarbonate but contains relatively more CO₂. The solution therefore contains more NH₃ than corresponds to NH₄HCO₃. The synthetic sealed tube method was used and the temperatures determined at which complete solution occurred in known mixtures of NH₄HCO₃ and H₂O. At temperatures above 60° very small tubes were used and in order to avoid danger of explosion these were placed in an electrically heated metal block with a hole, protected by glass plates, through which the tube could be observed by transmitted light. The determinations were plotted and the following values taken from the curve. They agree with previous determinations except at the higher temperatures.

t°	Gms. NH ₄ HCO ₃ per 100 gms. sat. sol.	Solid Phase	t°	Gms. NH ₄ HCO ₃ per 100 gms. sat. sol.	Solid Phase
-3.9 Eutec	9.5	Ice + NH ₄ HCO ₃	50	31.6	NH ₄ HCO ₃
0	10.6 (10.6)		60	37.2	"
10	13.9 (13.8)	NH ₄ HCO ₃	70	44.0	"
20	17.8 (17.3)	"	80	52.2	"
25	19.9 (19.2)	"	90	63.0	"
30	22.1 (21.3)	"	100	78.0	"
40	26.8 (24.9)	"	108 m.pt.	100.0	"

The results in parentheses are the averages of the previous determinations of Fedotieff, 1904; Nishizawa, 1920; Toparescu, 1922; and Fedotieff and Kolossoff, 1923.

THE SYSTEM AMMONIA, CARBON DIOXIDE AND WATER. (Terres and Weiser, 1921.)

The saturated solutions were prepared by mixing various amounts of ammonium bicarbonate, carbonate or carbamate with water or aqueous solutions of ammonia and rotating at constant temperature for many days or weeks. The original tables show the composition of the mixtures used to obtain saturation with respect to one or the other of the several solid phases. In the following tables (1) designates ammonium bicarbonate, NH₄ H CO₃, (2) ammonium carbonate (NH₄)₂ CO₃ H₂ O, (3) ammonium carbamate NH₂ CO₂ NH₄, (1.2) designates the double salt 2 NH₄ HCO₃ (NH₄)₂ CO₃ H₂ O, (1.3) the double salt, NH₄ H CO₃ · NH₂ CO₂ NH₄.

Results at 0°.1

Results at 20°.

Results at 40°.

Gms. per 100 gms. sat. sol.			Gms. per 100 gms. sat. sol.			Gms. per 100 gms. sat. sol.		
NH ₃ .	CO ₂ .	Solid Phase.	NH ₃ .	CO ₂ .	Solid Phase.	NH ₃ .	CO ₂ .	Solid Phase.
2.6	6.05	(1)	3.95	9.25	(1)	6.18	14.05	(1)
8.8	12.1*	"	4.8	9.77*	"	7.2	14.9	"
10.6	14.0	"	9.3	13.9	"	10.2	17.0*	—
11.2	14.8*	(1) + (1.2)	9.4	15.1*	"	13.8	20.1*	—
14.2	17.8*	(1.2)	14.2	18.8	—	14.6	21.5	(1)
14.3	18.1*	"	16.0	20.4	"	17.3	24.4*	"
14.4	18.2	"	17.3	21.8	(1) + (1.2)	17.7	24.8	"
15.1	17.6	(2)	17.3	22.0	"	19.6	27.0*	—
15.0	18.0	"	18.5	23.2	(1.2)	20.3	28.1*	(1)
15.2	17.4*	"	19.5	24.3	"	21.0	28.2	(1) + (1.3)
15.8	17.1*	"	19.6	24.4	"	21.0	28.4	"
16.5	15.8*	"	20.0	24.8*	"	22.3	28.9*	(1.3)
17.5	13.2	"	20.1	24.8*	(2) + (1.2)	23.3	29.4	"
23.7	13.3*	"	20.3	25.0*	"	24.0	29.8*	"
25.4	13.3*	"	20.2	24.9	"	25.25	30.5	—
25.6	12.8	"	20.6	24.8	(2)	26.5	31.1	(1.3)
26.5	14.9*	"	22.0	24.8	"	27.8	31.8	"
26.5	12.7*	(?)	25.8	24.4*	"	28.1	32.3*	"
28.7	12.0	(2)	26.6	24.4	"	28.6	32.4	"
33.2	13.6	(2) + (3)	28.6	24.0	"	29.1	32.6	"
35.6	12.3*	(?)	27.8	24.0	"	29.8	32.7	(1.3) + (3)
38.9	11.5*	(3)	29.8	24.2	(2) + (3)	29.5	32.6	"
39.7	11.6	"	29.7	23.8	"	29.9	32.5	(3)
45.0	11.2	"	31.2	23.8	(3)	30.5	31.2	"
19.5	3.6**	(2)	32.0	23.4	"	32.0	28.7	"
20.8	8.8**	"	33.5	22.9	"	33.2	27.2*	"
25.0	6.5**	"						

* Indicates that equilibrium was approached from above. ** Indicates incomplete equilibrium.

Results similar to the above are also given for 60°. A number of determinations between 20° and 40° were made to fix the transition temperatures in this region.

The following results for the solubility of Ammonium bicarbonate in water are taken from the tables.

t°.	Gms. NH ₄ H (O), per 100 gms. sat. sol.	Solid Phase
0.....	11.1	NH ₄ · HCO ₃
20.....	17.5	"

AMMONIUM CARBONATE

EQUILIBRIUM IN THE SYSTEM AMMONIA, CARBON DIOXIDE
AND WATER AT TEMPERATURES ABOVE 60°.
(Terres and Behrens, 1928.)

Due to the high pressures at temperatures above 60° glass vessels could not be used for the solubility determinations, small steel bombs of 150 to 250 cc.capacity were therefore employed. The interior walls of these were coated with enamel or ebonite, or in the case of still higher temperatures, glass cylinders inside the bombs were used.

Results at 80°

Results at 100°

Results at 120°

Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase
NH_3	CO_2		NH_3	CO_2		NH_3	CO_2	
10.5	21.0	(1)	11.2	24.0	(1)	16.2	28.5	melted (1)
13.5	23.9	"	13.4	25.0	"	21.2	32.0	"
16.9	26.1	"	18.6	29.2	"	23.9	36.3	"
20.2	28.8	"	20.6	31.1	"	24.5	34.9	"
22.0	31.4	"	24.3	35.0	"	25.6	37.4	"
25.9	34.6	"	28.1	40.0	" + (3)	26.5	39.2	"
27.5	37.5	"	29.6	40.2	(3)	25.7	38.1	"
37.75	31.7	(1.3)	31.0	39.7	"	29.8	40.6	(3)
37.0	41.2	(3)	33.2	39.8	"	32.1	40.5	"
35.6	40.0	"	34.8	39.7	"	34.8	40.3	"
34.4	40.8	"	35.9	40.0	"	36.0	40.7	"

CO

(1) = NH_4HCO_3 , (3) = $\text{NH}_2\text{CO}_2\text{NH}_4$, (1.3) = $\text{NH}_4\text{HCO}_3 \cdot \text{NH}_2\text{CO}_2\text{NH}_4$.

Additional results at 133°-135° for the Urea field are given. The authors also give the following additional results for the solubility of ammonium bicarbonate in water, which like their previous ones at lower temperatures, fail to agree with the determinations of Janecke, 1929.

t°	Gms. NH_4HCO_3 per 100 gms. sat. sol.
80	36.3
100	45.5
106 m.pt.	—
120	48.6

NH₄

AMMONIUM

1068

AMMONIUM CARBONATE

EQUILIBRIUM IN THE SYSTEM AMMONIA, CARBON DIOXIDE AND WATER.
(Janecke, 1929a.)

The synthetic sealed tube method was used for determination of the temperatures of complete solution or appearance of immiscible layers in all possible mixtures of the three components. The mixtures were prepared from weighed amounts of either ammonium bicarbonate or carbamate and aqueous ammonia solutions of given concentrations. In those mixtures containing a large excess of ammonia, liquid NH₃ was distilled at very low temperature into the tubes containing the salt and water. On account of the danger of explosion in these cases the tubes were incased in a metal cylinder and observed by light transmitted through protected windows. For observation of the point of complete solution at low temperatures the tubes were first cooled in a mixture of liquid CO₂ and acetone until a solid phase separated and then allowed to warm to the temperature at which this solid phase just disappeared. More than 300 such observations were made and from the diagram plotted from them the values for isotherms and the invariant points were obtained. The solid phases were identified analytically and microscopically.

The previous results of Terres and Weiser, 1921, and Terres and Behrens, 1928 are shown to be in error due to imperfections in the method employed, except at temperatures below 60° and when the solid phase is bicarbonate or sesquicarbonate. The two solid phases reported by Terres in addition to the four here mentioned are shown not to exist. In the following table (1) designates ammonium bicarbonate, NH₄HCO₃, (2) ammonium carbonate, (NH₄)₂CO₃·H₂O, (3) ammonium carbamate NH₄COONH₂ and 1.2 ammonium sesqui carbonate (NH₄)₂CO₃·2NH₄HCO₃.

CO

t°	Gms. per 100 gms. sat. sol.		Solid Phase	t°	Gms. per 100 gms. sat. sol.		Solid Phase
	NH ₃	CO ₂			NH ₃	CO ₂	
-95	81.0	0.5(?)	(3)+NH ₃ +(NH ₄) ₂ O 10	15	19		(1)
-85	59.0	0.5(?)	(3)+NH ₃ OH+ " 4	20	17.5		(2)
-80	47.0	0.5(?)	(3)+ " + (2) "	25	15.8		"
-95	34.0	0.5(?)	Ice+ " + (2) "	30	15.3		"
-13	11.0	14.5	" + (1) + (2) "	35	16.0		"
-10	11.5	15.5	(3)+ (1) "	35	17.0		" + (3)
-10	9.5	12.5	Ice+ (1) "	40	17.0		(3)
-5	6.0	9.0	" + " "	45	14.3		"
0	14.0	18.0	(3)+ (1) "	50	12.0		"
"	5.0	8.5	(1) "	60	8.5		"
"	10.0	13.7	" "	70	5.0		"
"	15.0	17.0	(2) "	15.5	20.0		(1)+(1.2)
"	20.0	19.5	" "	5	10.8		(1)
"	25	9.0	" "	10	15.0		"
"	30	8.0	" "	15	20.0		"
"	35	8.5	" "	20	22.5		(2)
"	40	10	" "	25	21.0		"
"	42	11	" + (3) "	30	21.5		"
"	45	10	(3) "	35	22.8		"
"	50	8.5	" "	36	23.0		" + (3)
"	60	6.0	" "	40	20.3		(3)
"	70	4.0	" "	45	17.5		" "
5	15	19.5	(1)+(1.2)+(2) "	50	14.7		"
10	5	9.6	(1) "	60	10.5		"
"	10	14.3	" "	70	6.0		"

AMMONIUM CARBONATE

EQUILIBRIUM IN THE SYSTEM AMMONIA, CARBON DIOXIDE
AND WATER. (Continued.)

(Jänecke, 1929a.)

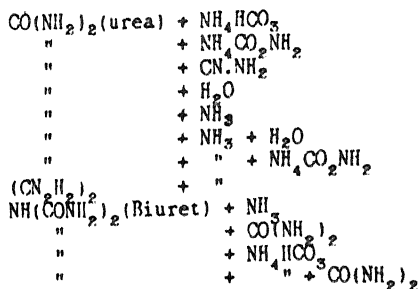
t°	Gms. per 100 gms. sat. sol.		Solid Phase	t°	Gms. per 100 gms. sat. sol.		Solid Phase
	NH_3	CO_2			NH_3	CO_2	
20	16	21.0	(1)+(1.2)	40	50	21	(3)
30	10	16.2	(1)	"	60	15.5	"
"	17	23.0	" + (1.2)	"	70	10.5	"
"	20	25	(1.2)	43	30	33	" + (2)+(1.2)
"	25	26	(2)	50	10	19.2	(1)
"	30	26.5	"	"	15	23	"
"	33.5	27.0	" + (3)	"	18	27	" + (1.2)
"	35	26	(3)	"	20	27.7	(1.2)
"	40	23	"	"	25	32	"
"	45	20.3	"	"	29	35	" + (3)
"	50	17.5	"	"	30	35	(3)
"	60	13.0	"	"	40	29	"
"	70	8.5	"	"	45	26.5	"
40	10	17.3	(1)	"	50	23.7	"
"	15	22	"	"	60	19.0	"
"	17.5	25	" + (1.2)	"	70	15.0	"
"	20	26.7	(1.2)	60	19	29.0	(1)+(1.2)
"	25	29.5	"	"	28	38	(3)+ "
"	30	32.0	(2)	70	22	33.5	(1)+ "
"	31.5	32	" + (3)	"	27.5	40	(3)+ "
"	35	29	(3)	80	24.5	39	(1)+ "
"	40	26	"	"	27	42	(3)+ "
"	45	23.2	"	85	27	44	" + " + (1)

CO

Above 50° two liquid layers are formed. The compositions of these, as derived from the diagram, are as follows.

t°	Liquid Layer I		t°	Liquid Layer II	
	NH_3	CO_2		NH_3	CO_2
50	80	3.5	70	15	
60	85	2.5	65	20	
70	58	2	63	26	
80	91	1.5	59	32	
90	93	1.5	57.5	35	
100	95	0.5	57	37.5	
110	97	0.5	57	40.5	

In continuation of his studies upon the System Ammonium, Carbon Dioxide and Water, Janecke, 1930, and Janecke and Rahlfs, 1932, give freezing-point, solubility and vapor pressure determinations of the following systems.



SOLUBILITY OF AMMONIUM CARBONATE IN AQUEOUS SOLUTIONS
OF AMMONIUM CHLORIDE AND VICE VERSA.

(Mondain Monval, 1922.)

Results at 0°.		Results at 18°.	
Gms. per 100 gms. H ₂ O.		Gms. per 100 gms. H ₂ O.	
NH ₄ Cl.	¹ / ₂ (NH ₄) ₂ CO ₃ .	NH ₄ Cl.	¹ / ₂ (NH ₄) ₂ CO ₃ .
0.00	55.8	10.1	62.0
26.4	56.7	14.5	61.2
27.2	13.0	31.3	61.0
29.2	0.0	31.7	17.6

CO

SOLUBILITY OF AMMONIUM CARBONATE IN AQUEOUS SOLUTIONS
OF SODIUM CARBONATE AND VICE VERSA.

(Mondain Monval, 1922.)

Results at 0°.			Results at 13°.		
Gms. per 100 gms. H ₂ O.		Solid Phase.	Gms. per 100 gms. H ₂ O.		Solid Phase.
$\frac{1}{2}$ Na ₂ CO ₃ .	$\frac{1}{2}$ (NH ₄) ₂ CO ₃ .		$\frac{1}{2}$ Na ₂ CO ₃ .	$\frac{1}{2}$ (NH ₄) ₂ CO ₃ .	
18.0	64.2	(NH ₄) ₂ CO ₃ + Na ₂ CO ₃	4.3	59.2	(NH ₄) ₂ CO ₃
10.3	12.9	Na ₂ CO ₃	15.9	65.2	» + Na ₂ CO ₃
6.9	0.5	»	27.6	16.3	Na ₂ CO ₃
7.1	0.0	»	27.6	16.5	»

SOLUBILITY OF MIXTURES OF AMMONIUM CARBONATE, AMMONIUM CHLORIDE
AND OTHER SALTS IN WATER AT 0° AND AT 15°. (Mondain Menval, 1922.)

Results at 0° :				Results at 15° :				Solid Phase at both temperatures.
Gms. per 100 gms. H ₂ O.				Gms. per 100 gms. H ₂ O.				
Na.	NH ₄ .	Cl.	1/2 CO ₂ .	Na	NH ₄ .	Cl.	1/2 CO ₂ .	
11.0	6.5	27.0	2.5	9.4	7.2	27.8	0.8	NH ₄ Cl + NaCl
11.7	10.9	23.1	14.1	13.6	10.8	30.2	10.2	" + " + Na ₂ CO ₃
14.6	1.7	21.1	4.2	13.3	6.0	23.3	7.7	NaCl + Na ₂ CO ₃
9.7	11.0	21.7	12.6	12.7	14.3	28.2	16.6	NH ₄ Cl + "
9.2	38.4	22.6	56.6	18.5	39.4	38.5	57.2	" + " + (NH ₄) ₂ CO ₃
6.2	34.8	19.9	49.4	10.3	35.4	31.2	46.0	" + (NH ₄) ₂ CO ₃
1.8	31.1	17.5	39.3	2.3	31.7	21.4	37.7	" + "
6.8	24.5	4.8	45.4	10.9	38.8	21.4	60.8	Na ₂ CO ₃ + "
2.3	10.1	19.9	3.1	4.1	12.0	23.7	5.4	NH ₄ Cl
7.0	6.4	12.6	9.1	10.6	10.7	21.7	13.8	Na ₂ CO ₃
7.1	4.2	8.3	9.3	7.9	2.3	4.6	10.3	"
3.5	1.5	3.0	4.5	—	—	—	—	"

AMMONIUM BICARBONATE

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AMMONIUM NH₄

SOLUBILITY OF AMMONIUM BICARBONATE IN AQUEOUS SOLUTIONS OF AMMONIUM CHLORIDE SATURATED WITH CO₂.

(Fedotieff — Z. phys. Ch. 49, 168, '04.)

t°.	Wt. of 1 cc. Sol.	Per 1000 cc. Solution.				Per 1000 Grams H ₂ O.			
		G. M. NH ₄ Cl.	G. M. NH ₄ HCO ₃ .	Gms. NH ₄ Cl.	Gms. NH ₄ HCO ₃ .	G. M. NH ₄ Cl.	G. M. NH ₄ HCO ₃ .	Gms. NH ₄ Cl.	Gms. NH ₄ HCO ₃ .
0	...	...	...	...	...	0.0	1.22	0.0	119.0
0	1.077	4.41	0.37	235.9	29.2	5.42	0.46	290.8	36.0
15	1.064	0.0	2.12	0.0	167.2	0.0	2.36	0.0	186.4
15	1.063	0.5	1.84	26.8	145.2	0.56	2.06	29.9	162.9
15	1.062	1.0	1.59	53.5	125.5	1.13	1.80	60.6	142.2
15	1.062	1.41	1.42	75.4	112.2	1.59	1.60	85.1	126.9
15	1.065	1.89	4.28	100.8	101.1	2.18	1.48	116.8	116.8
15	1.069	2.87	0.99	153.3	78.2	3.42	1.18	183.0	93.3
15	1.076	3.84	0.79	205.2	62.5	5.03	0.98	269.3	77.3
15	1.085	4.82	0.65	257.9	51.4	6.21	0.84	332.5	66.4
15	1.085	4.95	0.62	264.8	48.9	6.40	0.81	343.5	64.2
30	...	...	...	...	...	0.0	3.42	0.0	270.0
30	...	...	...	...	...	7.4	1.15	397.0	91.0

SOLUBILITY OF AMMONIUM BICARBONATE IN AQUEOUS SOLUTIONS OF SODIUM BICARBONATE SATURATED WITH CO₂.

(Fedotieff.)

t°.	Wt. of 1 cc. Sol.	Per 1000 cc. Solution.				Per 1000 Grams H ₂ O.			
		G. M. NaHCO ₃ .	G. M. NH ₄ HCO ₃ .	Gms. NaHCO ₃ .	Gms. NH ₄ HCO ₃ .	G. M. NaHCO ₃ .	G. M. NH ₄ HCO ₃ .	Gms. NaHCO ₃ .	Gms. NH ₄ HCO ₃ .
0	...	...	...	...	...	0.0	1.51	0.0	119.0
0	1.072	0.53	1.28	44.6	101.4	0.58	1.39	48.2	109.4
15	1.064	0.0	2.12	0.0	167.2	0.0	2.36	0.0	186.4
15	1.090	0.63	1.92	52.5	151.3	0.71	2.16	59.2	170.6
30	...	...	...	...	...	0.0	3.42	0.0	270.0
30	...	...	...	...	...	0.83	2.91	70.0	230.0

SOLUBILITY OF AMMONIUM BICARBONATE IN AQUEOUS SOLUTIONS OF AMMONIUM NITRATE.

(Fedotieff and Koltunoff, 1914.)

t°.	d of Sat. Sol.	Gms. per 100 Gms. H ₂ O.		t°.	d of Sat. Sol.	Gms. per 100 Gms. H ₂ O.	
		NH ₄ NO ₃ .	NH ₄ HCO ₃ .			NH ₄ NO ₃ .	NH ₄ HCO ₃ .
0		0	11.90	15	1.242	103.4	8.25
0	1.265	118	4.52	15	1.269	128.9	7.79
15	1.064	0	18.64	15	1.302	166.9	7.46
15	1.113	23.26	12.91	30	...	0	26.96
15	1.164	49.82	10.33	30	...	231.9	12.57

SOLUBILITY OF MIXTURES OF AMMONIUM BICARBONATE, SODIUM BICARBONATE, AND AMMONIUM CHLORIDE IN WATER SATURATED WITH CO₂.

(Fedotieff.)

°.	Wt. of 1 cc. Sol.	Gram Mols. per 1000 Gms. H ₂ O.			Gms. per 1000 Gms. H ₂ O.			Solid Phase.
		NaHCO ₃ .	NaCl.	NH ₄ Cl.	NaHCO ₃ .	NaCl.	NH ₄ Cl.	
0	1.114	0.59	0.96	4.92	49.61	56.16	263.4	a + b + c
0	1.187	0.12	4.83	2.74	10.09	282.6	146.7	"
15	1.116	0.93	0.51	6.28	78.18	29.84	336.2	"
15	1.178	0.18	4.44	3.73	15.13	259.8	199.6	"
15	1.151	0.30	3.09	4.56	25.22	180.8	244.1	a + c
15	1.128	0.51	1.68	5.45	42.87	98.28	291.7	"
15	1.112	0.99	0.35	5.65	83.22	20.47	302.4	a + b
15	1.108	1.07	0.20	5.21	89.95	11.70	278.9	"
15	1.106	1.12	0.11	4.92	94.14	6.44	263.4	"
15	1.101	1.16	0.14	4.00	97.52	8.19	214.1	"
15	1.090	0.93	0.95	2.03	78.18	55.53	108.6	"

a = NaHCO₃,

b = NH₄HCO₃,

c = NH₄Cl.

CO

SOLUBILITY OF AMMONIUM BICARBONATE AT 35° IN AQUEOUS SOLUTIONS OF :
(Fedotieff and Kolossof, 1923.)

Ammonium Sulfate :				Sodium Bicarbonate.			
d ₂₀ of sat. sol.	Gms. per 100 gms. H ₂ O.		Solid Phase.	d ₂₀ of sat. sol.	Gms. per 100 gms. H ₂ O.		Solid Phase.
	(NH ₄) ₂ SO ₄ .	NH ₄ HCO ₃ .			NaHCO ₃ .	NH ₄ HCO ₃ .	
1.19	28.73	22.95	NH ₄ HCO ₃	1.11	0.0	31.08	NH ₄ HCO ₃
1.23	37.19	21.18	"	1.16	7.12	29.32	" + NaHCO ₃
1.26	56.71	17.00	"	1.15	7.38	28.72	NaHCO ₃
1.34	75.78	15.57	" + (NH ₄) ₂ SO ₄	1.11	9.51	9.78	"
1.32	77.31	10.18	(NH ₄) ₂ SO ₄	1.11	10.59	3.99	"
1.25	80.74	0.00	"	1.08	11.66	0.00	"

100 gms. H₂O simultaneously saturated at 15° with :

Ammonium Bicarbonate + Ammonium Chloride contain 7.02 gms. NH₄HCO₃ + 35.4 gms. NH₄Cl
" " + Sodium Bicarbonate " 19.6 " 6.2 gms. NaHCO₃

The following results were obtained for water simultaneously saturated with three salts at 15°.

Gms. per 100 gms. H ₂ O.				Solid Phase.
NH ₄ .	Na.	HCO ₃ .	Cl.	
11.2	3.4	5.9	24.5	NH ₄ HCO ₃ + NaHCO ₃ + NH ₄ Cl
6.6	10.5	1.2	29.3	NaCl + " + "

(Toporescu, 1922.)

SIMULTANEOUS SOLUBILITY OF AMMONIUM BICARBONATE AND OTHER SALTS (Nishizawa, 1920.)

t°.	Gm. mols. per 1000 gm. mols. H_2O .		Solid Phase.	t°.	Gm. mols. per 1000 gm. mols. H_2O .		Solid Phase.
	$(\text{NH}_4)_2\text{SO}_4$	NH_4HCO_3			NaHCO_3	NH_4HCO_3	
15..	96.40	14.90	$(\text{NH}_4)_2\text{SO}_4 + \text{NH}_4\text{HCO}_3$	15..	12.79	38.92	$\text{NaHCO}_3 + \text{NH}_4\text{HCO}_3$
30..	99.27	24.60	»	30..	12.38	37.96	»
40..	100.9	34.0	»	40..	15.87	70.83	»

t°.	Gm. mols. per 1000 gm. mols. H_2O .			Solid Phase.
	Na_2SO_4	$(\text{NH}_4)_2\text{SO}_4$	NaHCO_3	
15.....	12.46	67.08	20.90	$\text{NH}_4\text{HCO}_3 + \text{NaHCO}_3 + \text{Na}_2\text{SO}_4 \cdot (\text{NH}_4)_2\text{SO}_4 \cdot 4\text{H}_2\text{O}$
30.....	11.27	87.04	27.56	»
40.....	10.03	109.1	34.59	»
15.....	6.79	97.99	14.96	» + $(\text{NH}_4)_2\text{SO}_4$ +
30.....	8.68	104.06	24.66	»
40.....	9.79	109.2	35.48	»

AMMONIUM Bi CARBONATE

Results for the system Ammonium Bicarbonate, Ammonium Sulfate and Water at 15° are given by Wolfkowitzsch, Belokolski and Lebedew, 1931.

EQUILIBRIUM IN THE RECIPROCAL SALT PAIR, AMMONIUM BICARBONATE AND SODIUM CHLORIDE AT 20° TO 40° AND UNDER 1.2 TO 2.5 ATMOSPHERES PRESSURE OF CARBON DIOXIDE.

(Neumann and Domke, 1928.)

The authors mention that few previous studies of the equilibrium in the ammonia soda process have been made under conditions resembling closely those of the actual manufacturing process. This consists in saturating natural or artificial sodium chloride brine with ammonia and treating this with 30-40 vol. percent CO_2 under pressure. The authors have therefor made determinations at 20° to 40° and under 1.2 and 2.5 atmospheres pressure of CO_2 with results which permit the calculation of the yield of sodium and ammonium for each varying composition of the solution.

Results for Aqueous Solutions with one or two salts under 1.2 Atmospheres Pressure of CO_2 and at:

20°

30°

40°

The system $\text{NH}_4\text{Cl} + \text{NaCl} + \text{H}_2\text{O}$

Gms. per 1000 cc sat. sol.		Gms. per 1000 cc sat. sol.		Gms. per 1000 cc sat. sol.	
NH_4Cl	NaCl	NH_4Cl	NaCl	NH_4Cl	NaCl
294.2	0.0	315.7	0.0	337.8	0.0
241.6	82.3	291.5	36.2	307.2	44.5
202.8	150.5	236.1	127.3	263.3	115.7
172.1	206.0	199.9	191.7	228.2	177.1
52.4	279.8	116.5	243.1	77.2	268.7
37.5	289.3	63.6	274.5	0.0	316.0
0.0	312.3	0.0	314.4		

NH₄ AMMONIUM

t = 20°

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t = 30°

t = 40°

The system NaCl + NaHCO₃ + H₂O

Gms. per 1000 cc sat. sol.		Gms. per 1000 cc sat. sol.		Gms. per 1000 cc sat. sol.	
NaCl	NaHCO ₃	NaCl	NaHCO ₃	NaCl	NaHCO ₃
312.3	0.0	314.4	0.0	316.0	0.0
310.9	9.92	311.3	12.6	311.9	15.6
143.0	33.3	103.2	47.3	178.6	35.6
45.5	61.7	34.1	80.0	98.5	56.9
0.0	90.8	0.0	104.2	0.0	119.6

The system NH₄HCO₃ + NaHCO₃ + H₂O

Gms. per 1000 cc sat. sol.		Gms. per 1000 cc sat. sol.	
NaHCO ₃	NH ₄ HCO ₃	NaHCO ₃	NH ₄ HCO ₃
90.8	0.0	104.2	0.0
68.9	89.4	88.1	64.0
55.4	171.0	64.2	200.3
0.0	183.2	60.7	228.6
		0.0	241.4

The System NH₄Cl + NH₄HCO₃ + H₂O

Gms. per 1000 cc sat. sol.		Gms. per 1000 cc sat. sol.	
NH ₄ Cl	NH ₄ HCO ₃	NH ₄ Cl	NH ₄ HCO ₃
294.2	0.0	315.7	0.0
288.8	15.7	290.1	85.0
276.1	55.9	260.1	91.4
167.2	83.8	210.6	107.4
93.3	117.9	163.3	125.2
0.0	183.2	74.5	177.2
		24.2	216.9

AMMONIUM CARBONATE

EQUILIBRIUM IN THE RECIPROCAL SALT PAIR AMMONIUM BICARBONATE AND SODIUM CHLORIDE. (Continued.)

(Neumann and Donke, 1928.)

Results for Aqueous Solutions Simultaneously Saturated with Two Salts, and under 1.2 Atmospheres Pressure of CO₂

Solid Phase NaHCO₃ + NH₄Cl

t°	Gms. per 1000 cc sat. sol.		
	NaHCO ₃	NH ₄ Cl	NaCl
20	21.8	213.5	125.7
"	25.2	220.4	112.2
"	29.4	230.3	93.5
30	49.6	271.2	60.8
"	31.1	243.4	110.5
"	30.4	241.8	112.8
"	27.1	231.7	130.4

Solid Phase NaHCO₃ + NH₄HCO₃

t°	Gms. per 1000 cc sat. sol.		
	NaHCO ₃	NH ₄ HCO ₃	NH ₄ Cl
20	68.1	67.2	109.1
"	68.9	68.8	106.5
"	62.2	94.1	74.4
30	68.9	127.3	95.8
"	66.4	136.0	85.6
"	65.5	148.6	71.2
"	64.7	157.3	63.7

Results for Aqueous Solutions Simultaneously Saturated with Three Salts, and under 1.2 Atmospheres Pressure of CO_2

Solid Phase $\text{NaHCO}_3 + \text{NH}_4\text{Cl} + \text{NaHCO}_3$ Solid Phase $\text{NaHCO}_3 + \text{NH}_4\text{Cl} + \text{NaCl}$

t°	Gms. per 1000 cc sat. sol.			t°	Gms. per 1000 cc sat. sol.		
	NaHCO_3	NH_4Cl	NaHCO_3		NaHCO_3	NH_4Cl	NaCl
20	68.8	273.9	17.5	20	14.2	169.0	206.6
30	80.7	301.5	15.8	30	19.3	193.1	192.3
				40	27.7	218.8	178.7

Results for the above Systems under 2.5 Atmospheres Pressure of CO_2 .

20	63.0	268.6	18.7 (NaCl?)	20	12.6	32.1	196.4
30	83.2	302.8	7.1 (NaCl?)	30	19.3	55.2	181.2
				40	25.2	78.1	164.9

100 cc sat. solution of unaltered ammonium carbonate in U.S.P. Ethyl Alcohol contain 2.12 gms. $(\text{NH}_4)_2\text{CO}_3$ at 25°. (E'we, 1920.)

100 gms. carefully purified glycerol dissolve 20 gms. $(\text{NH}_4)_2\text{CO}_3$ at 15°. (Ossendowski, 1907.)

AMMONIUM Uranyl CARBONATE $2(\text{NH}_4)_2\text{CO}_3\text{UO}_2\text{CO}_3$.

(Eichmen.)

100 grams H_2O dissolve 5 grams of the salt at 15°.

AMMONIUM OXALATE $(\text{NH}_4)_2\text{C}_2\text{O}_4 \cdot \text{H}_2\text{O}$.

SOLUBILITY OF AMMONIUM OXALATE IN WATER.

(Hill and Distler, 1935.)

t°	Gms. $(\text{NH}_4)_2\text{C}_2\text{O}_4$ per 100 gms. sat. sol.	t°	Gms. $(\text{NH}_4)_2\text{C}_2\text{O}_4$ per 100 gms. sat. sol.	t°	Gms. $(\text{NH}_4)_2\text{C}_2\text{O}_4$ per 100 gms. sat. sol.
0	2.314	30	5.738	70	15.10
10	3.112	40	7.565	80	18.30
20 (1.0169)	4.259	50	9.735	90	21.84
25 (1.0188)	4.953	60	12.25	100	25.73

The solid phase is $(\text{NH}_4)_2\text{C}_2\text{O}_4 \cdot \text{H}_2\text{O}$ in all cases. The results in parentheses are densities of the sat. solution determined by Flöttmann, 1928. In addition to the above very careful determinations, results for the solubility of ammonium oxalate in water at temperatures up to 50° are also given by Engel, 1888; Foote and Andrew, 1905; Wandstra, 1912; Colani, 1916; Koenig, 1922 and Guignes, 1927.

AMMONIUM OXALATE

SOLUBILITY IN AQUEOUS SOLUTIONS OF OXALIC ACID.
(Woudstra, 1912.)

Results at 30°. (Interpolated
from Original.)

Results at 45°.

Gms. per 100 (COONH ₄) ₂ .	Gms. Sat. Sol. (COOH) ₂ .	Solid Phase.	Gms. per 100 (COONH ₄) ₂ .	Gms. Sat. Sol. (COOH) ₂ .	Solid Phase.
0.14	12.36	A	0.22	21.22	A
0.28	12.78	A+T	0.31	21.31	"
0.30	12	T	0.53	20.54	A+T
0.39	10	"	0.56	21.23	T
0.47	8	"	0.61	20.55	"
0.52	7	"	0.54	20.92	"
0.68	6	"	0.79	16.44	"
1	5	"	1.23	12.88	"
2	3.96	"	7.16	7.98	"
3	3.61	"	3.54	5.83	"
4	3.60	"	5.65	5.67	"
5	3.81	"	6.72	5.95	"
5.98	4.21	T+A. O.	8.74	6.53	T+A. O.
7	3.63	A. O.	8.93	6.27	A. O.
8.19	3.36	A. O.+N. O.	9.04	6.14	"
7	2.32	N. O.	12.38	5	A. O.+N. O.
6	1.02	"	8.31	3.04	N. O.
5.53	0.22	"	9.59	1.45	"

A. = Oxalic Acid (COOH)₂.H₂O.

A. O. = Acid Ammonium Oxalate (COO)₂HNH₄.H₂O.

T = Ammonium tetroxalate (COOH)₂(COO)₂HNH₄.2H₂O.

N. O. = Neutral Ammonium Oxalate (COONH₄)₂.H₂O.

Additional data for this system at 25° are given by Walden (1905), and at 0° by Engel (1888).

SOLUBILITY IN WATER OF MIXTURES OF AMMONIUM OXALATE AND:

Other Oxalates at 25°.

(Foote and Andrew, 1905.)

Other Ammonium Salts.

(Colani, 1916.)

Gms. per 100 (COONH ₄) ₂ .H ₂ O.	Gms. Sat. Solution.	t°.	Gms. per 100 (COONH ₄) ₂ .	Gms. Sat. Solution.
2.79	+25.96 (COOK) ₂ .H ₂ O	15	0.14	+26.35 NH ₄ Cl
4.8	+5.75 (COOLi) ₂	50	0.67	+32.55 "
5.45	+0.59 (COO) ₂ Mg.2H ₂ O	18	0.11	+42.43 (NH ₄) ₂ SO ₄
6.19	+1.45 (COO) ₂ Zn.2H ₂ O	50	0.65	+45.92 "
5.06	+0.28 (COO) ₂ Cd.3H ₂ O	19	0.085	+62.26 NH ₄ NO ₃
		50	0.35	+72.11 "

Both salts in excess in every case. No double salts formed.

SOLUBILITY OF AMMONIUM OXALATE IN AQUEOUS SOLUTIONS OF SODIUM OXALATE
AND VICE VERSA.
(Rivett and O'Conner, 1919.)

Results at 23°.				Results at 30°.			
d of sat. sol.	Gms. per 100 gms sat. sol.		Solid Phase.	d of sat. sol.	Gms. per 100 gms. sat. sol.		Solid Phase.
	Na ₂ C ₂ O ₄ .	(NH ₄) ₂ C ₂ O ₄ .			Na ₂ C ₂ O ₄ .	(NH ₄) ₂ C ₂ O ₄ .	
I.028	0.89	4.88	(NH ₄) ₂ C ₂ O ₄ ·H ₂ O	I.042	I.25	9.46	(NH ₄) ₂ C ₂ O ₄ ·H ₂ O
I.035	I.82	4.81	»	I.051	2.45	9.32	»
I.043	2.85	4.75	»	I.059	3.57	9.21	»
I.047	3.41	4.74	» + Na ₂ C ₂ O ₄	I.063	4.05	9.19	» + Na ₂ C ₂ O ₄
I.043	3.46	3.77	Na ₂ C ₂ O ₄	I.056	4.13	7.86	Na ₂ C ₂ O ₄
I.039	3.51	2.89	»	I.049	4.29	6.12	»
I.037	3.51	2.48	»	I.044	4.28	4.64	»
I.033	3.65	I.49	»	I.036	4.37	3.14	»
I.030	3.63	0.74	»	I.031	4.46	I.59	»
I.027	3.73	0.00	»	I.023	4.54	0.00	»

SOLUBILITY OF AMMONIUM OXALATE AND OF AMMONIUM THORIUM OXALATE
IN WATER AT 25°.

(James, Whittemore and Holden, 1914.)

The mixtures were constantly agitated for periods varying from many weeks to several months.

Gms. per 100 Gms. H ₂ O.		Solid Phase.	Gms. per 100 Gms. H ₂ O.		Solid Phase.
(NH ₄) ₂ C ₂ O ₄ .	Th(C ₂ O ₄) ₂ .		(NH ₄) ₂ C ₂ O ₄ .	Th(C ₂ O ₄) ₂ .	
5.25	0	(NH ₄) ₂ C ₂ O ₄	29.47	39.10	2.I.7 + 2.I.2
6.04	I.54	"	23.04	29.87	2.I.2
7.78	4.51	"	16.84	21.18	"
10.37	8.87	"	13.27	15.96	"
15.46	16.89	"	8.13	9.13	"
21.47	26.37	"	5.36	5.63	"
28.18	36.54	" + 2.I.7	I.70	I.42	"

COO

2.I.7 = 2Th(C₂O₄)₂·(NH₄)₂C₂O₄·7H₂O; 2.I.2 = 2Th(C₂O₄)₂·(NH₄)₂C₂O₄·2H₂O.

100 gms. 95% formic acid dissolve 6.2 gms. (NH₄)₂C₂O₄ at 21°. (Aschan, 1913.)

100 cc. anhydrous hydrazine dissolve 44 gms. (NH₄)₂C₂O₄ at room temp.
with evolution of ammonia. (Welsh and Broderson, 1915.)

EQUILIBRIUM IN THE SYSTEM AMMONIUM OXALATE, ZIRCONIUM OXALATE AND WATER.
(Boulanger, 1936.)

Results at 19°		Results at 39°		Solid Phase at each
Gms. per 100 gms. sat. sol.		Gms. per 100 gms. sat. sol.		
(NH ₄) ₂ C ₂ O ₄	ZrOC ₂ O ₄	(NH ₄) ₂ C ₂ O ₄	ZrOC ₂ O ₄	
4.33	0.0	6.95	0.0	(NH ₄) ₂ C ₂ O ₄ ·H ₂ O
4.72	0.52	6.90	1.26	"
5.25	0.82	6.84	1.35	"
5.39	0.96	6.60	1.40	(?)
5.70	1.30	6.20	1.70	(?)
6.05	1.74	6.15	1.97	2(NH ₄) ₂ C ₂ O ₄ ·ZrOC ₂ O ₄ ·H ₂ C ₂ O ₄ ·2H ₂ O(?)
5.53	1.34	5.46	1.80	"
5.10	1.25	4.91	1.76	"
4.43	1.21	4.61	1.60	"
3.05	0.8	3.95	1.45	"

unfilterable gels

SOLUBILITY OF AMMONIUM OXALATE IN AQUEOUS SOLUTIONS OF ACETONE AT 17.6°.
(Hartley, 1931.)

Mol. (CH ₃) ₂ CO per 1.0 mol. (CH ₃) ₂ CO + H ₂ O	Mol. NH ₄ C ₂ O ₄ per 1.0 mol. sat. sol.	Mol. (CH ₃) ₂ CO per 1.0 mol. (CH ₃) ₂ CO + H ₂ O	Mol. NH ₄ C ₂ O ₄ per 1.0 mol. sat. sol.
0.0000	0.00604	0.0344	0.00352
0.0136	0.00488	0.0544	0.00261
0.0273	0.00395	0.0668	0.00219

AMMONIUM Ferric and Ferrous OXALATES

SOLUBILITY OF EACH SEPARATELY IN METHYL ALCOHOL.
(Henstock, 1934.)

Salt	Formula	t°	Gms. salt per 100 gms. CH ₃ OH
Ammonium Ferrous Oxalate (NH ₄) ₂ Fe(C ₂ O ₄) ₂		15	0.47
" " "	" "	66 (b. pt.)	0.78
" Ferric " (NH ₄) ₃ Fe(C ₂ O ₄) ₃		15	0.42
" " "	" "	66 (b. pt.)	0.72

AMMONIUM CHLORIDE NH₄Cl.

THE ICE CURVE FOR THE SYSTEM AMMONIUM CHLORIDE-WATER.
(Rodebush, 1918.)

C1 The temperatures were measured with a thermoclement and the concentrations determined by conductivity.

t° of lowering of f. pt.	Gms. NH ₄ Cl per 100 gms. H ₂ O.	t° of lowering of f. pt.	Gms. NH ₄ Cl per 100 gms. H ₂ O.	t° of lowering of f. pt.	Gms. NH ₄ Cl per 100 gms. H ₂ O.
0.0.	0.0	— 8.60.	13.76	— 12.60.	19.93
— 5.73.	9.28	— 10.58.	16.89	— 14.03.	22.40
— 7.63.	12.27	— 11.80.	18.80	— 15.10.	24.13
— 7.80.	12.56	— 12.44.	19.94	— 15.36 (Eutec.)	24.50

Similar determinations for concentrations of NH₄Cl up to 0.5 normal are given by Klein and Svanberg, 1920.

SOLUBILITY OF AMMONIUM CHLORIDE IN WATER.

Mulder; below 0°, Meerburg, 1903. More recent determinations at several temperatures in satisfactory agreement with the results of Meerburg are given by Benrath, 1927; Gerassimow, 1930; Aronowa and Lunskaia, 1931.)

t°.	Gms. NH ₄ Cl per 100 Gms.		t°.	Gms. NH ₄ Cl per 100 Gms.	
	Solution.	Water.		Solution.	Water.
— 15	19.7	24.5	40	31.4	45.8
— 10.9	20.3	25.5	50	33.5	50.4
— 5.7	21.7	27.7	60	35.6	55.2
0	22.7	29.4	70	37.6	60.2
+ 5	23.8	31.2	80	39.6	65.6
10	24.9	33.3	90	41.6	71.3
15	26.0	35.2	100	43.6	77.3
20	27.1	37.2	110	45.6	83.8
25	28.2	39.3	115.6	46.6	87.3
30	29.3	41.4			

Density of saturated solution at 0° = 1.088, at 15° = 1.077, at 19° = 1.075. Eutectic, Ice + NH₄Cl = — 16° and 19.5 gms. NH₄Cl per 100 gms. sat. sol. 100 gms. H₂O dissolve 31.75 gms. NH₄Cl at 3.5°, 38.5 gms. at 25° and 49.6 gms. at 50°.

(Biltz and Marcus, 1911.)
Data for the solubility of ammonium chloride in water at 0° under pressures up to 500 atmospheres are given by Stackelberg, 1896.

SOLUBILITY OF AMMONIUM CHLORIDE IN WATER AT TEMPERATURES
ABOVE 100° DETERMINED BY THE SYNTHETIC METHOD.

(Benrath, Gjedebø, Schiffers and Wunderlich, 1937.)

t°	Gms. NH ₄ Cl per 100 gms. sat. sol.	t°	Gms. NH ₄ Cl per 100 gms. sat. sol.	t°	Gms. NH ₄ Cl per 100 gms. sat. sol.
100	44.0	180	57.3	275	71.5
120	48.0	200	60.5	300	75.3
140	50.7	225	64.5	350	82.3
160	54.0	250	68.0	400	89.0

SOLUBILITY OF AMMONIUM CHLORIDE IN AQUEOUS HYDROCHLORIC ACID.

Results at 0° (Engel, 1888.)			Results at 25° (Armstrong and Eyre, 1910-11.)		
Sp. Gr. of Sat. Sol.	Gms. per 100 cc. sat. sol. HCl.	NH ₄ Cl.	Gms. HCl per 100 Gms. H ₂ O.	d 20 Sat. Sol.	Gms. NH ₄ Cl per 100 Gms. Sat. Sol.
1.076	0	24.61	0	1.080	28.3
1.069	1.05	23.16	0.91	1.079	27.4
1.070	1.99	21.78	1.82	1.082	26.4
1.073	3.93	19.36	3.05	1.083	24.6
1.078	7.74	14.54	18.25	1.099	11.3
1.106	19.18	5.78			
1.114	22.07	4.67			

EQUILIBRIUM IN THE SYSTEM AMMONIUM CHLORIDE
AMMONIUM DICHROMATE AND WATER.

(Gerassimow, 1930.)

t°	Gms. per 100 gms. sat. sol.		Solid Phase	t°	Gms. per 100 gms. sat. sol.		Solid Phase
	(NH ₄) ₂ Cr ₂ O ₇	NH ₄ Cl			(NH ₄) ₂ Cr ₂ O ₇	NH ₄ Cl	
0	0.0	22.9	NH ₄ Cl	50	0.0	33.5	NH ₄ Cl
"	0.948	24.42	" + (NH ₄) ₂ Cr ₂ O ₇	"	5.771	31.22	" + (NH ₄) ₂ Cr ₂ O ₇
"	3.58	15.52	(NH ₄) ₂ Cr ₂ O ₇	"	25.13	11.96	(NH ₄) ₂ Cr ₂ O ₇
"	15.37	0.0	"	"	32.06	6.46	"
19.8	1.940	26.69	NH ₄ Cl	"	42.03	0.0	"
"	1.964	26.60	" + (NH ₄) ₂ Cr ₂ O ₇	75	0.0	38.64	NH ₄ Cl
"	7.489	17.31	(NH ₄) ₂ Cr ₂ O ₇	"	1.619	37.43	"
"	8.687	15.10	"	"	2.984	36.84	"
"	14.362	8.414	"	"	11.406	33.17	" + (NH ₄) ₂ Cr ₂ O ₇
"	19.54	4.219	"	"	17.21	35.77	(NH ₄) ₂ Cr ₂ O ₇
"	26.23	0.0	"	"	31.45	16.68	"
				"	39.84	9.41	"
				"	47.36	2.59	"
				"	52.13	0.0	"

AMMONIUM CHLORIDE

SOLUBILITY OF AMMONIUM CHLORIDE IN AQUEOUS SOLUTIONS
OF POTASSIUM DICHROMATE AND OF POTASSIUM PERMANGANATE AT 25°.
(Hers and Hiebsenthal, 1929.)

Results for Potassium Di Chromate Results for Potassium Permanganate.

Gm. Mols. per liter	
$K_2Cr_2O_7$	NH_4Cl
0.0	5.62
0.24	5.55
0.45	5.56
0.59	5.55
0.91	5.32

Gm. Mols. per liter	
$KMnO_4$	NH_4Cl
0.0	5.62
0.04	5.62
0.13	5.66
0.34	5.61
0.73	5.55

SOLUBILITY OF AMMONIUM CHLORIDE IN AQUEOUS AMMONIUM BICARBONATE SOLUTIONS SATURATED WITH CO₂. (Fedotieff - Z. Phys. Ch. 49, 169, 1904.)

t°.	Wt. of 1 cc. Sol.	Per 1000 cc. Solution.				Per 1000 Gms. H ₂ O			
		G. M. NH_4HCO_3	G. M. NH_4Cl	Gms. NH_4HCO_3	Gms. NH_4Cl	G. M. NH_4HCO_3	G. M. NH_4Cl	Gms. NH_4HCl	Gms. NH_4Cl
0	1.069	0.0	4.60	0.0	246.1	0.0	5.57	0.0	298.0
0	1.077	0.37	4.41	29.2	235.9	0.46	5.42	36.0	290.8
15	1.077	0.0	5.29	0.0	283.1	0.0	6.64	0.0	355.0
15	1.085	0.62	4.95	48.9	264.8	0.81	6.40	64.2	343.5
30	...	...	...	...	...	0.0	7.78	0.0	416.4
30	...	...	...	...	...	1.15	7.40	91.0	397.0

EQUILIBRIUM IN THE SYSTEM AMMONIUM CHLORIDE, AMMONIUM NITRATE AND WATER.

(Pruett, Brosheer and Maron, 1935.)

Results at 0.4°		Results at 25°		Results at 50°		Solid Phase at Each Temperature
Gms. per 100 NH_4NO_3	gms. sat. sol. NH_4Cl	Gms. per 100 NH_4NO_3	gms. sat. sol. NH_4Cl	Gms. per 100 NH_4NO_3	gms. sat. sol. NH_4Cl	
54.26	0	67.73	0.0	77.39	0.0	NH_4NO_3
50.53	3.39	64.73	3.82	74.07	3.90	"
47.90	6.35	62.24	5.58	72.09	7.08	"
54.59	10.39	60.37	9.36	70.77	9.24	" + NH_4Cl
39.44	11.75	53.49	11.08	56.54	12.98	NH_4Cl
32.71	13.51	44.50	13.60	53.03	14.27	"
24.39	15.81	29.57	18.20	29.54	22.24	"
15.52	18.39	19.05	21.81	18.99	26.20	"
8.01	20.58	9.14	25.21	11.22	29.36	"
0.0	23.09	0.0	28.33	0.0	33.50	"

100 gms. H₂O dissolve 97.2 gms. NH_4Cl + 1000 gms. NH_4NO_3 at 100°.
(Wurmser, 1922.)

AMMONIUM CHLORIDE

EQUILIBRIUM IN THE SYSTEM AMMONIUM CHLORIDE AMMONIUM
NITRATE AND WATER.

(Jänecke, 1928.)

The results are given in terms of the Jänecke method of expressing such results, and the author found that the solid phases in contact with solutions containing the two salts, were composed of the salts and mixed crystals varying in content of NH_4Cl from 2 to 4 Mols. per 100 Mols.

t°	Mol. % NH_4Cl in dissolved salt mixture	Mols. H_2O to dissolve 100 mols. salt mixture	Solid Phase	t°	Mol. % NH_4Cl in dissolved salt mixture	Mols. H_2O to dissolve 100 mols. salt mixture	Solid Phase
0	100	1000	NH_4Cl	40	20	280	NH_4Cl
"	80	790	"	"	19	140	" NH_4NO_3
"	60	620	"	"	0	150	NH_4NO_3
"	40	450	"	60	100	540	NH_4Cl
"	22	310	" NH_4NO_3	"	80	420	"
"	20	300	NH_4NO_3	"	60	320	"
"	0	340	"	"	40	220	"
20	100	800	NH_4Cl	"	20	100	"
"	80	650	"	"	18	95	" NH_4NO_3
"	60	500	"	"	0	105	NH_4NO_3
"	40	350	"	80	100	450	NH_4Cl
"	23	200	" NH_4NO_3	"	17.5	60	" NH_4NO_3
"	20	190	NH_4NO_3	"	0.0	70	NH_4NO_3
"	0	210	"	100	100	390	NH_4Cl
40	100	650	NH_4Cl	"	17	35	" NH_4NO_3
"	80	530	"	"	0	50	NH_4NO_3
"	60	410	"	184	100	200	NH_4Cl
"	40	280	"	169	0	0	NH_4NO_3

Cl

SOLUBILITY IN AQUEOUS AMMONIA SOLUTIONS AT 0° .

(Engel — Bull. soc. chim. [3] 6, 17, 1891.)

Sp. Gr. of Solutions.	Milligram Molecules per 100 cc. Solution.		Grams per 100 cc. Solution.	
	NH_3	NH_4Cl	NH_4OH	NH_4Cl
I. 067	5.37	45.8	0.92	24.52
I. 054	12.02	45.5	2.05	24.35
I. 031	38.0	44.5	6.48	23.82
I. 025	47.0	44.0	8.02	23.56
I. 017	54.5	43.63	9.30	23.35
0.993	80.0	43.12	13.66	23.09
0.992	90.0	44.0	15.36	23.56
0.983	95.5	44.37	16.29	23.75
0.953	130.0	49.75	22.18	26.63
0.931	169.75	60.0	28.97	32.14

SOLUBILITY OF NH_4Cl IN AQUEOUS AMMONIA SOLUTIONS AT 17.5° .
(Strömholm, 1908)

Normality Equiv. per Liter.	Gms. per 1000 cc. Solution.	
	NH_3	NH_4Cl
0	5.435	290.8
0.15	5.420	290
4.76	5.082	81
		271.9

SOLUBILITIES OF MIXTURES OF AMMONIUM CHLORIDE AND OTHER SALTS IN WATER.

(Rüdorff, Karsten, Mulder.)

Both salts present in solid phase.

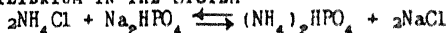
t°.	Grams per 100 Grams H ₂ O.			t°.	Grams per 100 Grams H ₂ O.		
19.5	20.2	NH ₄ Cl + 174.0	NH ₄ NO ₃ R	b pt	67.7	NH ₄ Cl + 21.9	KCl M
21.5	26.8	" + 46.5	(NH ₄) ₂ SO ₄ R	14.8	38.8	" + 34.2	KNO ₃ K
20.0	33.8	" + 11.6	BaCl ₂ R	18.5	39.8	" + 38.6	KNO ₃ K
18.5	39.2	" + 17.0	Ba(NO ₃) ₂ K	14.0	36.8	" + 14.1	K ₂ SO ₄ R
15.0	28.9	" + 16.9	KCl R	18.7	37.9	" + 13.3	K ₂ SO ₄ K
22.0	30.4	" + 19.1	KCl R	18.7	22.9	" + 23.9	NaCl R

EQUILIBRIUM IN THE SYSTEM AMMONIUM CHLORIDE, MONO BASIC AMMONIUM PHOSPHATE AND WATER AT 0°.

(Askensay and Nessler, 1970.)

d. of sat. sol.	Mol. % NH ₄ Cl in dissolved Salts	Mols. H ₂ O to dissolve 100 mols. salt mixture	Solid Phase	d. of sat. sols	Mol. % NH ₄ Cl in dissolved Salts	Mols. H ₂ O to dissolve 100 mols. Salt mixture	Solid Phase
1.0655	100.0	1000	NH ₄ Cl	1.0887	62.9	2060	NH ₄ H ₂ PO ₄
1.0831	98.3	990	"	1.0955	44.6	2270	"
1.0846	92.2	955	" + NH ₄ HPO ₄	1.0940	20.2	2450	"
1.0872	78.6	1490	NH ₄ H ₂ PO ₄	1.1043	0.0	2815	"

EQUILIBRIUM IN THE SYSTEM



(Lauffenburger and Brodsky, 1938.)

Results for Solutions Saturated with two salts.

t°	Gm. Mols. per 1000 gms. H ₂ O				Solid Phase
	NH ₄ Cl	NaCl	(NH ₄) ₂ HPO ₄	Na ₂ HPO ₄	
0	2.73	4.89	—	—	NH ₄ Cl + NaCl
"	6.22	—	3.47	—	" + (NH ₄) ₂ HPO ₄
"	—	—	3.14	0.08	Na ₂ HPO ₄ · 12H ₂ O + (NH ₄) ₂ HPO ₄
"	—	—	0.48	0.25	" + NaCl
"	—	5.95	—	1.00	" + NaCl
25	3.85	4.41	—	—	NH ₄ Cl + NaCl
"	6.65	—	1.53	—	" + (NH ₄) ₂ HPO ₄
"	—	—	5.14	0.14	Na ₂ HPO ₄ · 12H ₂ O + (NH ₄) ₂ HPO ₄
"	—	—	0.33	1.00	" + NaCl
"	—	5.70	—	0.50	" + NaCl

Results for Solutions Saturated with three salts.

t°	Gm. ions per 1000 gms. H ₂ O				Solid Phase
	Na ⁺	NH ₄ ⁺	PO ₄ H ⁻	Cl ⁻	
0	4.90	2.80	0.08	7.55	NH ₄ Cl + NaCl + Na(NH ₄)HPO ₄ · 4H ₂ O
"	0.30	10.1	2.65	5.1	" + (NH ₄) ₂ HPO ₄ + "
25	4.34	4.67	0.23	8.55	" + NaCl + "
"	6.51	0.40	0.46	5.99	NaCl + Na ₂ HPO ₄ · 12H ₂ O + "
"	0.45	9.04	1.64	6.21	NH ₄ Cl + (NH ₄) ₂ HPO ₄ + "

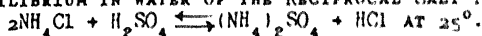
SOLUBILITY OF AMMONIUM CHLORIDE IN AQUEOUS SOLUTIONS OF AMMONIUM SULFATE AT 30°.

(Wibaut, 1909; Schreinemakers, 1910.)

Gms. per 100 Gms. Sat. Sol.		Solid Phase.	Gms. per 100 Gms. Sat. Sol.		Solid Phase.
$(\text{NH}_4)_2\text{SO}_4$	NH_4Cl		$(\text{NH}_4)_2\text{SO}_4$	NH_4Cl	
0	29.5	NH_4Cl	25	18.3	$\text{NH}_4\text{Cl} + (\text{NH}_4)_2\text{SO}_4$
5	28.5	"	30	13.2	$(\text{NH}_4)_2\text{SO}_4$
10	25.7	"	35	8.5	"
15	23.2	"	40	2.8	"
20	20.2	"	42	0	"

The heterogeneous equilibria in the quaternary system Ammonium Chloride + Ammonium Sulfate + Sodium Chloride + Sodium Sulfate + Water at 0°, 25°, 50°, 60° and 80° are given by Rivett, 1922.

EQUILIBRIUM IN WATER OF THE RECIPROCAL SALT PAIRS



(Blumberg and Zdanovsky, 1930.)

Mols. percent composition of dissolved components				Mols. H_2O per 100 mols. of dissolved components	Solid Phase
NH_4Cl	$(\text{NH}_4)_2\text{SO}_4$	H_2SO_4	2HCl		
—	100	—	—	964	$(\text{NH}_4)_2\text{SO}_4$
16.92	83.08	—	—	945	"
31.24	68.76	—	—	931	"
43.57	56.43	—	—	915	" + NH_4Cl
52.82	37.18	—	—	1115	NH_4Cl
80.34	19.66	—	—	1295	"
100.0	—	—	—	1516	"
76.47	—	—	23.53	1490	"
22.15	—	—	77.85	1166	"
8.29	—	—	91.71	801	"
6.39	—	—	93.61	565	" + (HCl)
—	—	—	100.0	578	(HCl)
—	—	99.30	0.70	0	" in (H_2SO_4)
—	31.60	68.40	—	0	$(\text{NH}_4)\text{HSO}_4$ in (H_2SO_4)
—	48.48	51.52	—	184	$(\text{NH}_4)\text{HSO}_4 + (\text{NH}_4)_2\text{H}(\text{SO}_4)_2$
—	69.90	30.10	—	459	$(\text{NH}_4)_2\text{SO}_4 +$

The authors also give results for solutions simultaneously saturated with ammonium chloride and the neutral and acid ammonium sulfates as well as all other mixtures required to complete the diagram for the 25° isotherm.

SOLUBILITY OF AMMONIUM CHLORIDE IN AQUEOUS SOLUTIONS OF SODIUM CHLORIDE AND VICE VERSA.

(Mondain Monval, 1922.)

Gms. per 100 gms. H_2O .			Solid Phase	Gms. per 100 gms. H_2O .			Solid Phase
°.	NaCl	NH_4Cl		°.	NaCl	NH_4Cl	
0.....	0.0	29.7	NH_4Cl	15.....	0.0	15.3	NH_4Cl
0.....	8.6	24.5	"	15.....	11.7	21.3	"
0.....	26.1	15.7	" + NaCl	15.....	24.2	20.4	" + NaCl
0.....	35.6	0.0	NaCl	15.....	27.2	16.9	NaCl
0.6...	23.86	20.0	NH_4Cl	15.9....	28.9	16.0	"
8.25..	24.05	22.3	"	24.1....	29.1	16.0	"

SIMULTANEOUS SOLUBILITY IN WATER OF AMMONIUM CHLORIDE AND SODIUM CHLORIDE.

t°.	Gms. per 100 gms. H ₂ O.		Solid Phase.	Authority.
	NaCl.	NH ₄ Cl.		
0.....	27.86	14.55	NaCl + NH ₄ Cl	(Sborgi and Franco, 1921.)
10.....	26.33	18.03	" "	" "
15.....	27.2	20.3	" "	(Toporescu, 1922.)
25.....	25.04	24.09	" "	(Sborgi and Franco, 1922.)
100.....	19.5	61.5	" "	(M ^{lle} Wurmser, 1922.)

SIMULTANEOUS SOLUBILITY OF AMMONIUM CHLORIDE AND SODIUM CHLORIDE IN WATER.

(Gerassimow, 1930.)

t°	Gms. per 100 gms. sat. sol.		Solid Phase
	NaCl	NH ₄ Cl	
0	19.78	10.26	NH ₄ Cl + NaCl
20	17.52	14.78	" "
50	14.26	22.5	" "
75	13.57	28.39	" "

Data for the simultaneous solubility in water at 100° of Ammonium chloride, Ammonium nitrate, Sodium chloride and Sodium nitrate are given by M^{lle} Wurmser, 1922.

100 gms. of *glycerol* of $d_{20} = 1.236$ dissolve 12.58 gms. NH₄Cl at 20° (Holm, 1922.)
 " " " = 1.2645 " 10.17 " " " " "

100 cc of a sat. sol. of ammonium chloride in pure *ethyl urethan* contain 0.131 gm. NH₄Cl at 60°. (Stuckgold, 1917.)

SOLUBILITY OF AMMONIUM CHLORIDE IN AQUEOUS SOLUTIONS OF SODIUM CHLORIDE SATURATED WITH CO₂.

(Fedotieff.)

t°.	Wt. of 1 cc. Sol.	Per 1000 cc. Solution.				Per 1000 Gms. H ₂ O.			
		G. M. NaCl.	G. M. NH ₄ Cl.	Gms. NaCl.	Gms. NH ₄ Cl.	G. M. NaCl.	G. M. NH ₄ Cl.	Gms. NaCl.	Gms. NH ₄ Cl.
0	1.069	0.0	4.60	0.0	246.1	0.0	5.57	0.0	298.0
0	1.185	4.04	2.26	236.5	121.0	4.89	2.73	286.4	146.1
15	1.077	0.0	5.29	0.0	283.1	0.0	6.64	0.0	355.0
15	1.097	0.81	4.71	47.5	252.1	1.02	5.91	59.8	316.4
15	1.120	1.68	4.13	98.0	221.7	2.09	5.18	122.4	277.0
15	1.153	2.87	3.38	168.0	180.7	3.57	4.20	208.9	224.7
15	1.175	3.65	2.98	213.5	159.4	4.55	3.72	266.8	198.8
30	...	...	...	...	...	0.0	7.78	0.0	416.4
30	1.166	3.30	3.70	193.0	198.0	4.26	4.77	249.0	255.4
45	...	...	...	...	...	0.0	9.03	0.0	483.7
45	...	...	...	...	...	4.0	6.02	233.9	322.1

THE SYSTEM AMMONIUM CHLORIDE + NICKEL CHLORIDE + WATER AT 70°. (Clendinnen, 1922.)

Gms. per 100 gms. sat. sol.	Per cent NH ₄ Cl in mixed crystals (extrapolated).		<i>d</i> of sat. sol.	Gms. per 100 gms. sat. sol.		Per cent NH ₄ Cl in mixed crystals (extrapolated).	
	NH ₄ Cl.	NiCl ₂ .		NH ₄ Cl.	NiCl ₂ .		
162	30.92	8.59	98.3	1.469	13.56	33.22	39.3
234	26.09	15.83	94.6	1.492	11.74	36.99	34.8
294	22.91	21.29	93.9	1.510	10.09	38.88	31.4
355	20.47	26.28	84.6	1.530	8.43	40.43	28.1
386	19.01	28.96	75.1	1.552	6.96	42.05	25.9
401	18.37	30.03	68.8	—	5.35	43.87	21.8
411	17.54	30.69	62.5	1.591	4.62	44.70	0.9
409	17.57	30.70	57.2	1.587	2.79	44.99	0.4
421	16.93	31.31	52.5	1.589	1.24	45.60	0.1
446	15.05	33.54	45.1	1.592	0.0	45.8	0.0

SOLUBILITY OF MIXTURES OF AMMONIUM AND NICKEL CHLORIDES IN WATER AT 25°. (Footc, 1912.)

Cl

Gms. per 100 Gms. Sat. Sol.	Solid Phase.	Gms. per 100 Gms. Sat. Sol.	Solid Phase.
NH_4Cl		NiCl_2	
26.07	Mixed crystals of NH_4Cl and $\text{NiCl}_2 \cdot 2\text{H}_2\text{O}$	7.98	Mixed crystals and $\text{NiCl}_2 \cdot 6\text{H}_2\text{O}$
22.27		8.07	
20.68		8.23	
17.43		8.17	
11.22		7.51	$\text{NiCl}_2 \cdot 6\text{H}_2\text{O}$
10.21		3.06	
9.16		0	
3.10		37.41	
8.04		37.73	
10.32		37.45	
15.01		37.64	
26.93		37.19	
30.56		37.98	
35.70		37.53	

AMMONIUM TinCHLORIDES

mono = $\text{NH}_4\text{SnCl}_3 \cdot \text{H}_2\text{O}$; Di = $(\text{NH}_4)_2\text{SnCl}_4 \cdot \text{H}_2\text{O}$; Tetra = $(\text{NH}_4)_4\text{SnCl}_6 \cdot \text{H}_2\text{O}$

SOLUBILITY OF STANNOUS MONOAMMONIUM CHLORIDE IN WATER.

(Rimbach and Fleck, 1916.)

Gms. NH_4SnCl_3 per 100 gms. sat. sol.	Solid Phase.	Gms. NH_4SnCl_3 per 100 gms. sat. sol.	Solid Phase.
t°.		t°.	
1.2*.... 57.0	$\text{NH}_4\text{SnCl}_3 \cdot \text{H}_2\text{O} + \text{SnCl}_2$	36.9.... 71.8	$\text{NH}_4\text{SnCl}_3 \cdot \text{H}_2\text{O}$
5.9*.... 63.1	"	61.7.... 80.0	"
		81.2.... 85.8	"

SOLUBILITY OF STANNOUS DIAMMONIUM CHLORIDE IN WATER.

Gms. $(\text{NH}_4)_2\text{SnCl}_4$ per 100 gms. sat. sol.	Solid Phase.	Gms. $(\text{NH}_4)_2\text{SnCl}_4$ per 100 gms. sat. sol.	Solid Phase.
t°.		t°.	
1.6.... 28.7	$(\text{NH}_4)_2\text{SnCl}_4 \cdot \text{H}_2\text{O}$	57.0.... 61.8	$(\text{NH}_4)_2\text{SnCl}_4 \cdot \text{H}_2\text{O}$
4.5.... 35.4	"	79.0.... 78.0	"
5.6.... 48.5	"		

SOLUBILITY OF STANNOUS TETRAMMONIUM CHLORIDE IN WATER.

t°.	Gms. per 100 gms. sol. sat.			Solid Phase.
	Cl.	Sn.	NH ₄ .	
0.8*.....	16.31	1.16	7.95	(NH ₄) ₄ SnCl ₆ ·H ₂ O + Sn ₂ Cl
19.1*.....	19.23	2.06	9.16	" "
41.7*.....	21.95	6.62	9.16	" "
58.1*.....	26.73	11.33	10.17	" "
70.1*.....	30.65	15.15	10.70	" "
81.3.....	31.98 +	19.60 +	10.30 =	61.9 gms. (NH ₄) ₄ SnCl ₆

* At these temperatures the atomic ratios of Cl : Sn : NH₄ in solution do not correspond to the double salt, hence in these cases the solid phase is a mixture of the double salt and stannous chloride.

SOLUBILITY OF AMMONIUM CHLORIDE IN AQUEOUS SOLUTIONS OF LEAD CHLORIDE AT 25° AND VICE VERSA.

(Wilkerson and Bathurst, 1977.)

Gms. per 1000 gms. H ₂ O		Solid Phase	Gms. per 1000 gms. H ₂ O		Solid Phase
PbCl ₂	NH ₄ Cl		PbCl ₂	NH ₄ Cl	
0.0	397.8	NH ₄ Cl	1.21	102.1	NH ₄ Cl. 2PbCl ₂
5.40	400.6	"	1.22	86.12	"
7.28	401.1	"	1.21	65.61	"
10.42	403.9	"	1.44	43.62	" + PbCl ₂
14.46	403.3	" + NH ₄ Cl. 2PbCl ₂	1.76	34.19	PbCl ₂
13.63	394.5	NH ₄ Cl. 2PbCl ₂	1.97	26.22	"
12.27	384.7	"	2.00	22.34	"
4.58	270.0	"	2.15	20.97	"
3.31	233.5	"	2.75	13.42	"
1.97	171.3	"	3.04	9.62	"
1.57	146.5	"	10.91	0.0	"

AMMONIUM Platinum CHLORIDE (NH₄)₂PtCl₆.

SOLUBILITY IN WATER. (Archibald and Kern, 1917.)

t°.	Gms. (NH ₄) ₂ PtCl ₆ per 100 gms. H ₂ O.	t°.	Gms. (NH ₄) ₂ PtCl ₆ per 100 gms. H ₂ O	t°.	Gms. (NH ₄) ₂ PtCl ₆ per 100 gms. H ₂ O.
0.0.....	0.2900	30.0.....	0.6370	70.0.....	1.7440
5.0.....	0.3550	40.0.....	0.8050	80.0.....	2.1605
10.0.....	0.3745	50.0.....	1.0250	90.0.....	2.6150
20.0.....	0.5000	60.0.....	1.4400	100.....	3.3650

SOLUBILITY IN AQUEOUS SOLUTIONS OF AMMONIUM CHLORIDE AT 20°.

Gms. Mols NH ₄ Cl per liter.	Gms. (NH ₄) ₂ PtCl ₆ per 100 gms. solvent.	Gms. Mols NH ₄ Cl per liter.	Gms. (NH ₄) ₂ PtCl ₆ per 100 gms. solvent.
0.10	0.0423	1.00	0.0028
0.20	0.0186	2.00	0.0024

SOLUBILITY OF MIXTURE OF AMMONIUM CHLORIDE AND LEAD CHLORIDE IN WATER AT SEVERAL TEMPERATURES.

(At 17°, 50° and 100° Demassieux (1913) at 25° Foote and Levy, 1907.)

At 17°.		At 25°.		At 50°.		At 100°.		Solid Phase in Each Case.
Gms. per 100	Gms. Sol.	Gms. per 100	Gms. Sol.	Gms. per 100	Gms. Sol.	Gms. per 100	Gms. Sol.	
PbCl_2	NH_4Cl	PbCl_2	NH_4Cl	PbCl_2	NH_4Cl	PbCl_2	NH_4Cl	
0.30	27.03	...	...	0.32	34.14	1.61	43.42	NH_4Cl
0.52	26.68	...	...	2.65	33.62	4.21	42.91	"
0.64	26.49	1.20	28.15	3.96	33.56	...	...	" + 1.2
...	...	...	...	...	...	9.26	41.90	" + 2.1
...	...	...	...	...	...	9.88	40.22	2.1
...	...	...	...	...	...	11.60	38.32	"
...	...	...	...	...	...	12.67	37.62	" + 1.2
0.34	22.32	0.93	27.45	3.31	31.90	11.40	36.20	1.2
0.098	12.36	0.35	21.59	1.76	27.16	8.32	32.64	"
0.078	4.93	0.29	17.97	0.71	19.42	4.54	26.08	"
0.078	4.23	0.11	10.25	0.49	12.45	1.98	13.12	"
0.076	3.48	0.03	2.77	0.48	4.86	1.76	8.59	" + PbCl_2
0.16	1.43	...	...	0.67	1.45	1.85	5.33	PbCl_2
0.21	0.96	...	...	1.08	0.51	2.02	1.32	"
0.89	0	...	...	1.69	0	3.10	0	"

1.2 = $\text{NH}_4\text{Cl} \cdot 2(\text{PbCl}_2)$, 2.1 = $2\text{NH}_4\text{Cl} \cdot \text{PbCl}_2$.

The following additional data for the above system at 22° are given by Brönsted (1909).

Gm. Equiv. NH_4Cl per 100 Gms. H_2O .	Gm. Equiv. PbCl_2 per 100 Gms. Sat. Sol.	Solid Phase.	Gm. Equiv. NH_4Cl per 100 Gms. H_2O .	Gm. Equiv. PbCl_2 per 100 Gms. Sat. Sol.	Solid Phase.
0	7.49×10^{-3}	PbCl_2	0.8	0.837×10^{-3}	$2\text{PbCl}_2 \cdot \text{NH}_4\text{Cl}$
0.1	3.10×10^{-3}	"	1	0.758×10^{-3}	"
0.2	1.916×10^{-3}	"	2	0.695×10^{-3}	"
0.4	1.348×10^{-3}	"	3	0.968×10^{-3}	"
0.5	1.263×10^{-3}	"	4	1.502×10^{-3}	"
0.55	1.189×10^{-3}	$2\text{PbCl}_2 \cdot \text{NH}_4\text{Cl}$	5	2.338×10^{-3}	"
0.6	1.092×10^{-3}	"	6	3.580×10^{-3}	"
0.7	0.956×10^{-3}	"	7.29 sat.	6.46×10^{-3}	" + NH_4Cl

The two curves intersect at 0.52 normal NH_4Cl .

SOLUBILITY OF AMMONIUM CHLORIDE IN AQUEOUS SOLUTIONS

OF METHYL ALCOHOL AT 25°.

(Akarlof and Turck, 1935.)

Wt. percent CH_3OH in solvent	Gm. Mols. NH_4Cl per 1000 gms. solvent	Wt. percent CH_3OH in solvent	Gm. Mols. NH_4Cl per 1000 gms. solvent
0.0	7.384	80.03	1.357
20.0	5.580	89.79	0.9305
40.82	3.893	94.76	0.7691
60.21	2.657	100.0	0.6612
72.39	1.731		

AMMONIUM CHLORIDE

SOLUBILITY OF AMMONIUM CHLORIDE IN AQUEOUS SOLUTIONS
OF ZINC CHLORIDE AND VICE VERSA.

(Meerburg, 1903.)

Isotherm for 0°.			Isotherm for 20°.			Isotherm for 30°.		
Gms. per 100 Gms. Solution.		Solid Phase.	Gms. per 100 Gms. Solution.		Solid Phase.	Gms. per 100 Gms. Solution.		Solid Phase.
ZnCl ₂ .	NH ₄ Cl.		ZnCl ₂ .	NH ₄ Cl.		ZnCl ₂ .	NH ₄ Cl.	
0	22.8	NH ₄ Cl	0.0	26.9	NH ₄ Cl	0.0	29.5	NH ₄ Cl
3.5	23.0	"	5.1	27.1	"	9.2	29.4	"
7.1	23.5	"	9.5	27.4	"	16.0	29.7	"
10.2	23.9	"	12.7	27.5	"	20.2	30.1	"
15.1	24.7	"	15.7	27.7	"	24.7	30.4	"
18.0	25.3	"	18.0	27.9	"	26.3	30.8	NH ₄ Cl + a
22.4	26.0	"	23.5	29.0	"	27.2	30.2	a
24.2	26.1	"	26.0	29.5	NH ₄ Cl + a	30.1	29.6	"
25.7	26.3	NH ₄ Cl + a	29.5	28.1	a	36.8	28.2	"
27.5	26.4	a	32.3	27.7	"	42.4	27.3	"
30.7	25.7	"	35.8	27.0	"	43.8	27.3	a + b
33.9	25.3	"	38.7	26.9	"	45.0	24.4	b
38.8	24.4	"	40.2	26.6	"	51.2	17.6	"
42.6	24.6	a + b	41.9	26.3	"	61.9	10.4	"
44.3	21.3	b	43.2	26.0	a + b	66.9	9.2	ZnCl ₂ + b
49.2	15.3	"	46.9	21.0	b	75.6	6.1	ZnCl ₂
52.6	11.9	"	53.2	14.5	"	70.3	7.6	"
55.4	10.0	"	58.4	11.1	"	78.5	3.2	"
59.3	7.5	"	62.7	8.7	"	76.9	3.5	"
62.1	6.8	"	66.6	7.9	"	79.8	1.6	"
						81.6	0.0	"

a = ZnCl₂·3NH₄Cl. b = ZnCl₂·2NH₄Cl.SOLUBILITY OF AMMONIUM CHLORIDE IN MIXTURES OF SEVERAL ALCOHOLS
WITH WATER.

(Armstrong, Eyre, Hussey and Paddington (1907); and Armstrong and Eyre (1910-11).)

t°.	Gm. Mols. Alcohol per 1000 Gms. H ₂ O.	Gms. NH ₄ Cl per 100 Gms. Sat. Solution in:		
		Aq. CH ₃ OH.	Aq. C ₂ H ₅ OH.	Aq. C ₃ H ₇ OH.
0	0	23	23	23
0	0.25	22.8	22.6	22.7
0	0.50	22.6	22.2	22.3
0	1	22.1	21.5	21.1
0	3	20.5	19	...
25	0	28.3	28.13 (1.0805)	28.3
25	0.25	28.1	28 (1.0780)	28.1
25	0.50	27.9	27.6 (1.0753)	27.5
25	1	27.6	27 (1.0704)	26.6
25	3	26.1	26.5 (1.0528)	...
25	5	...	22.6 (1.0376)	...

(Figures in parentheses show Sp. Gr. of sat. sols.)

SOLUBILITY OF AMMONIUM CHLORIDE IN AQUEOUS ETHYL ALCOHOL AT 15° AND AT 30° .

Gms. $\text{C}_2\text{H}_5\text{OH}$ per 100 Gms. Solvent.	Gms. NH_4Cl per 100 Gms. Solvent at:	
	15° .	30° .
0	35.2	40.4
20	25	29.7
40	16.8	19
60	9.5	11.1
80	4	5.3
92.3	1.3	...
100	0.6	...

Results at 15° by interpolation from Gerardin (1865), Greenish (1900) and deBruyn (1892). Those at 30° from Bathrick (1896).

100 gms. absolute methyl alcohol dissolve 3.35 gms. NH_4Cl at 19° . (deBruyn, 1892.)

100 gms. 98% methyl alcohol dissolve 3.52 gms. NH_4Cl at 19.5° . (deBruyn, 1892.)

Cl

SOLUBILITY OF AMMONIUM CHLORIDE IN SEVERAL ALCOHOL MIXTURES AT 25° .
(Herz and Kuhn, 1958.)

In Methyl and Ethyl Alcohol.		In Methyl and Propyl Alcohol.		In Propyl and Ethyl Alcohol.	
Gms. $\text{C}_2\text{H}_5\text{OH}$ per 100 Gms. Solvent.	Gms. NH_4Cl per 100 Gms. Sat. Solution.	Gms. $\text{C}_2\text{H}_5\text{OH}$ per 100 Gms. Solvent.	Gms. NH_4Cl per 100 Gms. Sat. Solution.	Gms. $\text{C}_2\text{H}_5\text{OH}$ per 100 Gms. Solvent.	Gms. NH_4Cl per 100 Gms. Sat. Solution.
0	0.53	0	2.76	0	0.53
10	0.67	10	2.33	10	0.50
20	0.80	20	1.90	20	0.47
30	0.98	30	1.58	30	0.42
40	1.18	40	1.26	40	0.39
50	1.40	50	1.03	50	0.36
60	1.65	60	0.82	60	0.32
70	1.92	70	0.60	70	0.30
80	2.18	80	0.41	80	0.26
90	2.48	90	0.30	90	0.22
100	2.76	100	0.18	100	0.18

AMMONIUM

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EQUILIBRIUM IN THE SYSTEM AMMONIUM CHLORIDE, TERTIARY BUTYL ALCOHOL AND WATER AT 30°.

(Ginnings and Robbins, 1930)

The points on the binodal curve of this system were determined by observing the appearance or disappearance of clouding in mixtures of weighed amounts of NH_4Cl and one of the liquids, upon addition of a weighed amount of the other. Tie lines, " ", were located by determination of the NH_4Cl in two liquid layers in contact with each other, and from these the plait point, PP, was found by plotting.

Gms. per 100 gms. sat. sol.		Gms. per 100 gms. sat. sol.		Gms. per 100 gms. sat. sol.	
ter. $(\text{CH}_3)_3\text{COH}$	NH_4Cl	ter. $(\text{CH}_3)_3\text{COH}$	NH_4Cl	ter. $(\text{CH}_3)_3\text{COH}$	NH_4Cl
82.0	2.0*	30.2	6.6	12.9	14.3
80.0	—*	27.5	7.4	11.8	15.6
70.2	2.4	25.3	8.0	11.0	16.8
65.0	—*	23.2	8.6	10.2	18.4
61.2	3.3	22.0	9.0	10.2	18.4
54.1	3.7	20.7	9.4	9.2	20.3
47.9	4.2	19.8	10.0	8.7	21.7
44.0	5.0PP	—	10.1*	—	22.7*
39.3	5.0	15.7	11.5	8.1	23.2
33.4	6.4	14.1	12.7	7.6	24.7*

In a later paper Ginnings, Herring and Webb, 1933, found the plait point of this system at 25° to be 37.6 gms. ter. $(\text{CH}_3)_3\text{COH}$ + 6.6 gms. NH_4Cl per 100 gms. sat. solution. The original results for the remaining points of the binodal curve are not given, but only values corresponding to derived empirical equations for the curve.

EQUILIBRIUM IN THE SYSTEM AMMONIUM CHLORIDE, DIOXAN AND WATER AT 25°.

(Herz and Lorentz, 1929.)

Vol. Percent $\text{C}_4\text{H}_8\text{O}_2$ in Aq. Solvent	Gm. Mol. NH_4Cl per liter sat. sol.	Vol. Percent $\text{C}_4\text{H}_8\text{O}_2$ in Aq. Solvent	Gm. Mol. NH_4Cl per liter sat. sol.
10	5.15	34 (lower layer)	1.50
20	4.50	97 (upper layer)	0.02
33	3.50		

EQUILIBRIUM IN THE SYSTEM AMMONIUM CHLORIDE, URETHAN AND WATER AT 25°.

(Palitzsch, 1928, 1929.)

Gm. Mols. per 1000 gms. H_2O		Solid Phase
NH_4Cl	$\text{NH}_2\text{COOC}_2\text{H}_5$	
7.411	0.0	NH_4Cl
7.254	1.123	"
7.0	3.07	" + $\text{NH}_2\text{COOC}_2\text{H}_5$
6.102	3.678	$\text{NH}_2\text{COOC}_2\text{H}_5$
0.0	53.09	"

SOLUBILITY OF AMMONIUM CHLORIDE IN AQUEOUS GLYCEROL SOLUTIONS AND
IN AQUEOUS ACETONE SOLUTIONS AT 25°.

(Herz and Knoch — Z. anorg. Chem. 45, 263, 267, '05.)

In Aqueous Glycerol.

(Sp. Gr. of Glycerine 1.255, Impurity about 1.5%.)

Wt. % Glycerine.	NH ₄ Cl per 100 cc. Solution.		Sp. Gr. at 25° 4°.
	Millimols.	Grams.	
0.	585.1	31.32	1.0793
13.28	544.6	29.16	1.0947
25.98	502.9	26.93	1.1127
45.36	434.4	23.26	1.1452
54.23	403.5	21.60	1.1606
83.84	291.4	15.60	1.2225
100.00	228.4	12.23	1.2617

In Aqueous Acetone.

Vol. % Acetone.	NH ₄ Cl per 100 cc. Solution.		Sp. Gr. at 25° 4°.
	Millimols.	Grams.	
0	585.1	31.32	1.0793
10	534.1	28.59	1.0618
20	464.6	24.87	1.0451
30	396.7	21.23	1.0263
40	328.5	17.59	0.9998
*46.5 L	283.7	15.19	0.9800
*85.7 U	18.9	1.01	0.8390
90	9.4	0.50	0.8274

* Between these two concentrations of acetone, the solution separates into two layers. L indicates lower layer, U indicates upper layer.

100 cc. anhydrous hydrazine dissolve 75 gms. NH₄Cl at room temp. with evolution of ammonia.

(Welsh and Broderson, 1915.)

SOLUBILITY OF AMMONIUM CHLORIDE IN ANHYDROUS ACETIC
ACID DETERMINED BY THE SYNTHETIC METHOD.

(Davidson and Chappell, 1938.)

t°	Mol. Percent NH ₄ Cl in sat. sol.	Solid Phase	t°	Mol. Percent NH ₄ Cl in sat. sol.	Solid Phase
16.60	0.0	CH ₃ COOH	58	0.150	NH ₄ Cl
16.53	0.053	"	65	0.178	"
21	0.053	NH ₄ Cl	72	0.209	"
25	0.065	"	77	0.224	"
32	0.084	"	84	0.259	"
38	0.095	"	87	0.282	"
43	0.110	"	92	0.312	"
53	0.134	"	98	0.348	"

Cl

One liter anhydrous CH₃COOH dissolve 0.7 gm. NH₄Cl at 16.56°.

(Eichelberger, 1934.)

SOLUBILITY OF AMMONIUM CHLORIDE IN LIQUID AMMONIA.

t°	Gms. NH ₄ Cl per 100 gms. NH ₃ cc sat. sol.		t°	Gms. NH ₄ Cl per 100 gms. NH ₃ cc sat. sol.	
-49.6	—	5.2 (1)	-37.2	—	8.6 (1)
-46.8	—	5.9 (1)	-34.6	—	9.6 (1)
-44.2	—	6.5 (1)	-33.9	14.75	9.63 (d=0.7492) (2)
-42.2	—	7.0 (1)	0	66.4	— (3)
-40.1	—	7.6 (1)	25	102.5	— (4)

(1) = Scherer, 1931; (2) = Johnson and Krumboltz, 1933;

(3) = Linhard and Stephan, 1933, 1934; (4) = Hunt, 1932.

SOLUBILITY OF AMMONIUM CHLORIDE IN LIQUID AMMONIA.

(Patschke and Tanne, 1935.)

t°	Gms. NH ₄ Cl per 100 gms. sat. sol.	Solid Phase	t°	Gms. NH ₄ Cl per 100 gms. sat. sol.	Solid Phase
-52.9	5.23	NH ₄ Cl.3NH ₃	8.2	49.20	NH ₄ Cl.3NH ₃
-39.3	10.00	"	9.1	50.50	"
-20.5	22.60	"	9.8	51.50	"
-11.8	29.50	"	9.3	52.50	"
+ 0.9	40.65	"	8.3	54.00	"
4.2	44.20	"	9.8 m.pt.	—	"
			36.9	55.40	NH ₄ Cl

The authors also give results for the -10°, 0° and + 10° isotherms of the system Ammonium Chloride, Sodium Chloride and Liquid Ammonia.

SOLUTIONS OF AMMONIUM CHLORIDE IN LIQUID AMMONIA

SOLUTIONS OF AMMONIUM NITRATE AND VICE VERSA AT 25°.

(Hunt and Boneyk, 1933.)

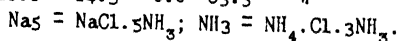
One-fourth gram of the less soluble salt was mixed with variable amounts of the more soluble salt and ammonia added in excess. Ammonia was then allowed to escape until a single crystal of one salt came out of solution. Identical results were obtained by approaching the saturation point from opposite sides.

Mols. per 10 Mols. NH ₃		Mols. per 10 Mols. NH ₃	
NH ₄ Cl	NH ₄ NO ₃	NH ₄ Cl	NH ₄ NO ₃
3.257	0.0	0.692	7.4
3.01	0.255	0.576	7.70
2.27	1.52	0.4875	7.82
0.903	4.83	0.0	8.2875
0.734	6.54		

EQUILIBRIUM IN THE SYSTEM AMMONIUM CHLORIDE, SODIUM CHLORIDE AND LIQUID AMMONIA.

(Akhoumow and Eserowa, 1936.)

t°	Gms. per 100 gms. sat. sol.			Solid Phase	t°	Gms. per 100 gms. sat. sol.			Solid Phase
	NaCl	NH ₄ Cl	NH ₃			NaCl	NH ₄ Cl	NH ₃	
-76.6	0.28	0.0	99.72	NH ₃ + Na ₂ S	-10.0	15.1	3.4	81.5	Na ₂ S + NaCl
-40	2.0	0.0	98.0	Na ₂ S	"	8.99	27.92	63.09	NH ₃ + "
"	2.7	1.35	95.95	"	"	0.0	30.87	69.13	NH ₃
"	3.2	3.2	93.6	"	-1.8	7.60	30.40	62.0	NH ₃ + NaCl
"	4.0	8.0	88.0	"	0	11.3	0.0	88.7	NaCl
"	4.1	11.9	84.0	" + NH ₃	"	3.92	39.2	56.88	" + NH ₃
"	2.9	11.6	85.5	NH ₃	"	4.86	37.49	57.65	" "
"	0.99	9.9	89.11	"	"	0.0	39.7	60.3	NH ₃
"	0.0	9.7	90.3	"	+8	0.0	54.61	45.39	" + NH ₄ Cl
-30	3.8	0.0	96.2	Na ₂ S	10	7.83	0.0	92.17	NaCl
"	8.5	17.0	74.5	" + NH ₃	"	0.85	56.15	43.0	" + NH ₄ Cl
"	0.0	15.0	85.0	NH ₃	"	1.22	50.81	47.97	" + "
-24.3	11.8	23.6	64.6	Na ₂ S + NaCl	"	0.0	55.10	44.90	NH ₄ Cl
-20	7.6	0.0	92.4	"	20	5.2	0.0	94.8	NaCl
"	14.1	22.9	63.0	" + NaCl	"	0.0	54.5	45.5	NH ₄ Cl
"	10.15	24.85	65.0	NH ₃ + "	30	3.3	0.0	96.7	NaCl
"	0.0	23.0	77.0	"	"	0.0	55.0	45.0	NH ₄ Cl
-16.3	15.8	15.8	68.4	Na ₂ S + NaCl	40	2.0	0.0	98.0	NaCl
-15.0	15.52	7.76	76.72	"	"	0.0	55.8	44.2	NH ₄ Cl
-10.0	14.5	0.0	85.5	"					



AMMONIUM CHLORIDE

100 gms. Liquid Sulfur Dioxide dissolve 0.009 gm. NH₄Cl at 0°.
(Jander and Wickert, 1936; Jander and Ruppolt, 1937.)

Fusion-point data are given for the following mixtures.

H ₄ Cl + SbCl ₃	(Kendall, Crittenden and Miller, 1923)	NH ₄ Cl + HgCl	(Jancke, 1911)
» + NH ₄ NO ₃	(Perman, 1922).	» + HgCl ₂	»
» + » + NaNO ₃	»	» + AgCl	»
» + NaCl + »	»	» + FeCl ₃	(Hackmeister, 1920)
» + NH ₄ NO ₃	(Bowen, 1926.)	» + LiCl	»
» + CdCl ₂	(Hackmeister, 1920.)	» + ZnCl ₂	»
» + CuCl	»		

Tetra Ethyl AMMONIUM CHLORIDE N(C₂H₅)₄Cl.

SOLUBILITY OF TETRA ETHYL AMMONIUM CHLORIDE IN SEVERAL SOLVENTS.
(Bjerrum and Josefowicz, 1932.)

Solvent	Formula	t°	d. of sat. sol.	Gms. N(C ₂ H ₅) ₄ Cl per 100 gms. sat. sol.	Solid Phase
Water	H ₂ O	20	1.0295	57.8	N(C ₂ H ₅) ₄ Cl. 4H ₂ O
"	"	35	1.034	75.45	N(C ₂ H ₅) ₄ Cl
Ethyl alcohol	CH ₃ OH	20	0.9587	69.9	"
"	"	35	0.9543	71.8	"
Thyl "	C ₂ H ₅ OH	20	0.9187	57.6	"
"	"	35	0.9163	60.2	"
Acetone	(CH ₃) ₂ CO	20	0.7913	0.137	"
"	"	35	0.7742	0.424	"

SOLUBILITY OF TETRA ETHYL AMMONIUM CHLORIDE N(C₂H₅)₄Cl, AND ALSO OF TETRA METHYL AMMONIUM CHLORIDE N(CH₃)₄Cl IN ACETONITRILE.

100 cc. sat. solution in CH₃CN contain 29.31 gms. N(C₂H₅)₄Cl at 25°.

100 cc. sat. solution in CH₃CN contain 0.265 gms. N(CH₃)₄Cl at 25°.

(Walden — Z. physik. Chem. 55, 712, '06)

SOLUBILITY OF TETRA ETHYL AMMONIUM CHLORIDE IN WATER AND IN CHLOROFORM.

(Peddle and Turner, 1914.)

100 gms. H₂O dissolve 141.0 gms. N(C₂H₅)₄Cl at 25°.

100 gms. CHCl₃ dissolve 8.24 gms. N(C₂H₅)₄Cl at 25°.

SOLUBILITY OF DIMETHYL AMMONIUM CHLORIDE IN WATER AND IN CHLOROFORM.

(Hantzsch, 1902.)

100 gms. H₂O dissolve 208 gms. of the salt.

100 gms. CHCl₃ dissolve 26.9 gms. of the salt (temp. not stated in abstract).

SOLUBILITY OF TETRA METHYL AMMONIUM CHLORIDE IN ETHYLENE DICHLORIDE
(CH₂Cl.CH₂Cl) CONTAINING VARIOUS ADDED SALTS AT 25°.
(Seward, 1934.)

It was necessary to remove all traces of moisture from the Ethylene Dichloride since as little as 0.02% H₂O causes the solubility of tetra methyl ammonium chloride to increase two fold. The determinations were made in presence of dry air.

Added Salt		Formula	Gm. Mols. per liter solvent Added Salt N(CH ₃) ₄ Cl	
None			0.0	0.0001143
Tetra methyl Ammonium Picrate		N(CH ₃) ₄ OC ₆ H ₂ (NO ₂) ₃	0.000375	0.0000837
"	"	"	0.000751	0.0000866
"	"	"	0.001125	0.0000987
Tetra ethyl Ammonium Nitrate		N(C ₂ H ₅) ₄ NO ₃	0.000267	0.000221
"	"	"	0.000500	0.000311
"	"	"	0.001000	0.000444
Tetra ethyl Ammonium Picrate		N(C ₂ H ₅) ₄ OC ₆ H ₂ (NO ₂) ₃	0.0005	0.000172
"	"	"	0.0010	0.000226
Tetra iso amyl Ammonium Picrate		N(C ₅ H ₁₁) ₄ OC ₆ H ₂ (NO ₂) ₃	0.0005	0.000162
"	"	"	0.0010	0.000185

C10 AMMONIUM PerCHLORATE NH₄ClO₄.

SOLUBILITY IN WATER.
(Carlton, 1910.)

t°.	Sp. Gr. Sat. Sol.	Gms. NH ₄ ClO ₄ per 100 cc. Sat. Sol.	t°.	Sp. Gr. Sat. Sol.	Gms. NH ₄ ClO ₄ per 100 cc. Sat. Sol.
0	1.059	11.56	80	1.193	48.19
20	1.098	20.85	100	1.216	57.01
40	1.128	30.58	107 b. pt.	1.221	59.12
60	1.158	39.05			

In a paper by Thin and Cumming (1915), it is stated that ammonium perchlorate is "sparingly soluble" in water and according to one determination at 14.2°, 100 gms. of the sat. solution was found to contain 1.735 gms. NH₄ClO₄. It is probable that these authors have misplaced the decimal point. This appears more probable since a determination of the solubility in 98.8 per cent ethyl alcohol at 25.2° gave 1.96 gms. NH₄ClO₄ per 100 gms. sat. solution, and in 98.8 per cent alcohol containing 0.2 per cent HClO₄ gave 1.97 gms. per 100 gms. sat. solution.

AMMONIUM PerCHLORATE NH₄ClO₄.

SOLUBILITY OF AMMONIUM PERCHLORATE IN WATER.
(Mazzucchelli and Rosa, 1921; Freeth, 1924.)

Gms. NH ₄ ClO ₄ per 100 gms. sat. sol.			Gms. NH ₄ ClO ₄ per 100 gms. sat. sol.		
t°.			t°.		
- 2.72 (Eutec.).	9.84 (M and R)	9.8 (Freeth)	45.1...	27.64 (M and R)	28.02 (Freeth)
0.0.....	10.73 "	10.74 "	55.2...	31.55 "	
+15.2.....	15.95 "	-	65.1...	35.37 "	
25.0.....	19.89 "	20.02 "	75.0...	39.05 "	39.45 "
34.0.....	23.32 "	-	84.7...	42.54 "	-

SOLUBILITY OF AMMONIUM PERCHLORATE IN AQUEOUS SOLUTIONS OF AMMONIUM SULFATE AND VICE VERSA.

(Freeth, 1924.)

Results at 25°.			Results at 60°.		
Gms. per 100	gms. sat. sol.	Solid Phase.	Gms. per 100	gms. sat. sol.	Solid Phase.
$(\text{NH}_4)_2\text{SO}_4$.	NH_4ClO_4 .		$(\text{NH}_4)_2\text{SO}_4$.	NH_4ClO_4 .	
0.0	20.02	NH_4ClO_4	7.04	28.56	NH_4ClO_4
11.06	13.11	"	11.89	24.91	"
22.45	8.15	"	16.69	21.66	"
33.75	4.25	"	23.71	17.02	"
41.70	3.00	" + $(\text{NH}_4)_2\text{SO}_4$	30.8	12.6	"
42.83	1.22	$(\text{NH}_4)_2\text{SO}_4$	40.92	8.2	" + $(\text{NH}_4)_2\text{SO}_4$
43.5	0.0	"	44.12	3.48	$(\text{NH}_4)_2\text{SO}_4$

SOLUBILITY OF AMMONIUM PERCHLORATE IN AQUEOUS SOLUTIONS OF SODIUM PERCHLORATE AND VICE VERSA.

(Freeth, 1924.)

Results at 25°.			Results at 60°.		
Gms. per 100	gms. sat. sol.	Solid Phase.	Gms. per 100	gms. sat. sol.	Solid Phase.
NaClO_4 .	NH_4ClO_4 .		NaClO_4 .	NH_4ClO_4 .	
9.29	15.07	NH_4ClO_4	12.35	25.78	NH_4ClO_4
25.85	9.54	"	25.0	18.00	"
43.64	4.87	"	37.34	12.54	"
52.86	3.50	"	56.95	6.30	"
67.42	1.51	" + $\text{NaClO}_4 \cdot \text{H}_2\text{O}$	72.86	1.87	" + NaClO_4
67.60	0.0	$\text{NaClO}_4 \cdot \text{H}_2\text{O}$	74.30	0.00	NaClO_4

Complete data for the quaternary equilibria in the system $\text{NH}_4\text{ClO}_4 + (\text{NH}_4)_2\text{SO}_4$, $\text{NaClO}_4 + \text{Na}_2\text{SO}_4 + \text{H}_2\text{O}$ at 25° and 60° are given by Freeth, 1924.

ClO

AMMONIUM Per CHLORATE

SOLUBILITY OF AMMONIUM PERCHLORATE IN AQUEOUS SOLUTIONS OF AMMONIA AT 25°.

(Kolthoff and Stenger, 1934.)

Normality of Aq. NH_3 Solvent	d. of sat. sol.	Gms. NH_4ClO_4 per 100	
		cc sat. sol.	gms. sat. sol.
0.0	1.095	21.40	19.64
0.443	1.092	21.63	19.81
0.876	1.089	21.98	20.16
1.303	1.088	22.50	20.68
1.731	1.086	22.96	21.14
2.59	1.084	24.08	22.23

SOLUBILITY OF AMMONIUM PERCHLORATE IN WATER AND IN SEVERAL ANHYDROUS SOLVENTS AT 25°.

(Willard and Smith, 1923.)

Solvent.	d_4^{25} of solvent.	d_4^{25} of sat. sol.	Gms. NH_4ClO_4 per 100 gms. sat. sol.	Solvent	d_4^{25} of solvent	d_4^{25} of sat. sol.	Gms. NH_4ClO_4 per 100 gms. sat. sol.
Water.....	-	1.0982	19.95	n Butyl alcohol..	0.8059	0.8069	0.017
ethyl alcohol..	0.78735	0.8218	6.41	iso Butyl alcohol.	0.7981	0.7988	0.127
ethyl alcohol...	0.78515	0.79505	1.872	Acetone.....	0.7859	0.7997	2.21
Propyl alcohol	0.7993	0.8016	0.385	Ethyl acetate....	0.8945	0.8947	0.032

SOLUBILITY OF AMMONIUM PERCHLORATE IN MIXTURES OF METHYL ALCOHOL AND ETHYL ACETATE AT 25°. (Smith, 1925.)

Volume per cent CH ₃ OH in Solvent.	Gms. NH ₄ ClO ₄ per 100 gms. sat. sol.	Volume per cent CH ₃ OH in Solvent.	Gms. NH ₄ ClO ₄ per 100 gms. sat. sol.
0.0 (=pure CH ₃ COO.C ₂ H ₅)	0.029	60.0	4.35
10.0	0.135	70.0	5.08
20.0	0.550	80.0	5.67
30.0	1.27	90.0	6.12
40.0	2.31	100.0	6.42
50.0	3.47		

100 gms. Liquid Sulfur Dioxide (SO₂) dissolve 0.025 gm. NH₄ClO₄ at 0°. (Jander and Ruppolt, 1937.)

100 gms. Liquid Ammonia (NH₃) dissolve 137.93 gms. NH₄ClO₄ at 25°. (Hunt and Boncyk, 1933.)

SOLUBILITY OF AMMONIUM PERCHLORATE AND SEVERAL OF ITS DERIVATIVES IN WATER AT 15°. (Hofmann, Höbald and Quos (1911-12).)

	Gms. Salt per 100 Gms. H ₂ O.		Gms. Salt per 100 Gms. H ₂ O.
NH ₄ ClO ₄	18.5	CH ₃ (C ₂ H ₅) ₃ NCIO ₄	23.6
CH ₃ NH ₃ ClO ₄	109.6	C ₃ H ₇ (C ₂ H ₅) ₃ NCIO ₄	7.9
(CH ₃) ₂ NH ₂ ClO ₄	208.7	(CH ₃) ₂ (C ₂ H ₅) ₂ NCIO ₄	134.3
C ₂ H ₅ NH ₃ ClO ₄	208.7	C ₂ H ₃ (CH ₃) ₃ NCIO ₄	5
(C ₂ H ₅) ₂ NH ₂ ClO ₄	150.9	BrC ₂ H ₄ (CH ₃) ₃ NCIO ₄	3.5
(CH ₃) ₃ NHClO ₄	19.9	BrC ₂ H ₂ (CH ₃) ₂ NCIO ₄	2.5
(CH ₃) ₄ NCIO ₄	0.5	(OH)C ₂ H ₄ (CH ₃) ₃ NCIO ₄	290.7
(C ₂ H ₅) ₄ NCIO ₄	3.7	(OH)CH ₂ CH(OH)CH ₂ (CH ₃) ₃ NCIO ₄	155.7
C ₆ H ₅ (CH ₃) ₃ NCIO ₄	17.9	NO ₃ C ₂ H ₄ (CH ₃) ₃ NCIO ₄	0.6
ICH ₂ (CH ₃) ₃ NCIO ₄	3.1	C ₃ H ₅ (CH ₃) ₃ NCIO ₄	199.5
C ₂ H ₅ (CH ₃) ₃ NCIO ₄	10.9	C ₂ H ₄ (NH ₃ ClO ₄) ₂	144.5
C ₃ H ₇ (CH ₃) ₃ NCIO ₄	15.4	C ₂ H ₄ [(CH ₃) ₃ NCIO ₄] ₂	1.2
C ₄ H ₉ (CH ₃) ₃ NCIO ₄	3.7	C ₃ H ₆ (CH ₃) ₃ NCIO ₄] ₂	1.5
C ₅ H ₁₁ (CH ₃) ₃ NCIO ₄	2.2	Br ₂ C ₂ H ₃ (CH ₃) ₃ NCIO ₄	2.2
		BrC ₃ H ₃ (CH ₃) ₃ NCIO ₄	2.6

Milbauer (1912-13) found that 100 gms. of cold H₂O dissolve 1.126 gm. tetramethyl ammonium perchlorate (CH₃)₄NCIO₄ and 100 gms. alcohol dissolve 0.04 gm. of the salt.

AMMONIUM CHROMATE (NH₄)₂CrO₄.

SOLUBILITY OF AMMONIUM CHROMATE IN WATER.

(Ouerassimow, 1934.)

t°	Gms. (NH ₄) ₂ CrO ₄ per 100 gms. sat. sol.
0	20.01
20	25.35
50	34.15
75	41.80

AMMONIUM CHROMATES.

SOLUBILITY IN WATER AT 30°.
(Schreinemaker—Z. phys. Chem. 55, 89, '00.)

Composition in Wt. per cent of:				Solid Phase
The Solution. % CrO ₃ .	% NH ₃ .	The Residue. % CrO ₃ .	% NH ₃ .	
6.933	22.35	...	...	(NH ₄) ₂ CrO ₄
9.966	16.53	47.50	20.44	"
16.973	8.20	...	...	"
22.53	6.37	38.03	12.15	"
27.09	6.87	48.02	12.01	(NH ₄) ₂ CrO ₄ + (NH ₄) ₂ Cr ₂ O ₇
26.19	5.70	47.38	8.81	(NH ₄) ₂ Cr ₂ O ₇
25.99	5.10	41.56	7.58	"
30.16	3.50	...	...	"
38.89	3.10	61.08	8.80	"
42.44	3.15	59.72	6.75	(NH ₄) ₂ Cr ₂ O ₇ + (NH ₄) ₂ Cr ₃ O ₁₀
44.08	2.27	54.90	4.14	(NH ₄) ₂ Cr ₃ O ₁₀
52.91	1.11	60.88	3.00	"
54.56	1.03	63.07	3.00	(NH ₄) ₂ Cr ₃ O ₁₀ + (NH ₄) ₂ Cr ₄ O ₁₃
56.57	0.97	65.70	2.95	(NH ₄) ₂ Cr ₄ O ₁₃
58.87	0.65	69.74	3.24	"
62.48	0.46	71.93	3.10	"
63.60	0.40	73.68	1.18	(NH ₄) ₂ Cr ₄ O ₁₃ + CrO ₃
63.66	0.41	71.47	2.07	"
62.94	0.21	...	...	CrO ₃
62.28	0.0	...	...	CrO ₃

0 gms. of the sat. aq. solution contain 28.80 gms. (NH₄)₂CrO₄ at 30°.

0 gms. of the sat. aq. solution contain 32.05 gms. (NH₄)₂Cr₂O₇ at 30°.

SOLUBILITY OF AMMONIUM CHROMATE IN AQUEOUS SOLUTIONS
OF AMMONIA AT 15°.

(Weitz and Stamm, 1925.)

The authors give several diagrams and a lengthy discussion of the solubility of ammonium chromate and other ammonium salts (bromide, chloride, chlorate, perchlorate, molybdate, nitrate, oxalate, sulfate, sulfite and dithionate) in aqueous solutions of ammonia. Some of the data are evidently taken from the literature and the rest are based on the experiments of Stamm. Numerical results are not given and the diagrams are not large enough to permit quantitative estimations. They show in general that the solubility of ammonium salts of monovalent acids increases and those of divalent acids decrease with increase of the concentration of ammonia.

THE SYSTEM AMMONIUM CHROMATE + AMMONIUM SULFATE + WATER AT 25°.

(Araki, 1925.)

Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase
(NH ₄) ₂ CrO ₄ .	(NH ₄) ₂ SO ₄ .		(NH ₄) ₂ SO ₄ .	(NH ₄) ₂ CrO ₄ .	
3.41	0.00	(NH ₄) ₂ SO ₄	34.82	6.98	Solid solutions of (NH ₄) ₂ SO ₄ in (NH ₄) ₂ CrO ₄
9.73	3.67	Solid solutions of (NH ₄) ₂ CrO ₄ in (NH ₄) ₂ SO ₄	30.81	9.01	
9.13	4.22		26.81	11.73	
9.11	4.23	Mixtures	17.18	16.76	
9.96	4.36	of the two series	14.47	17.76	
7.72	4.51		2.78	23.22	
8.06	4.88	of solid solutions	0.00	25.16	(NH ₄) ₂ CrO ₄

NH₄

AMMONIUM

1098

AMMONIUM Di CHROMATE (NH₄)₂Cr₂O₇.

SOLUBILITY OF AMMONIUM DICHROMATE IN WATER.

(Gerassimow, 1930.)

t°	Gms. (NH ₄) ₂ Cr ₂ O ₇ per 100 gms.:		t°	Gms. (NH ₄) ₂ Cr ₂ O ₇ per 100 gms.:	
	sat. sol.	H ₂ O		sat. sol.	H ₂ O
0	15.37	18.26	40	36.91	58.5
16	23.88 (1)	—	50	42.03	71.4
20	26.23	35.6	60	46.24	86.0
25	28.63 (1)	—	75	52.13	108.6
30	31.74	46.5	80	53.49	115.0
30	32.05 (2)	—	100	60.89	155.6

(1) = Moles and Gonzalez, 1923; (2) = Schreinemakers, 1905.

EQUILIBRIUM IN THE SYSTEM AMMONIUM DICHROMATE
SODIUM DICHROMATE AND WATER.

(Gerassimow, 1930.)

CrO

t°	Gms. per 100 gms. sat. sol.		Solid Phase	t°	Gms. per 100 gms. sat. sol.		Solid Phase
	(NH ₄) ₂ Cr ₂ O ₇	Na ₂ Cr ₂ O ₇			(NH ₄) ₂ Cr ₂ O ₇	Na ₂ Cr ₂ O ₇	
0	15.37	0.0	(NH ₄) ₂ Cr ₂ O ₇	75	52.13	0.0	(NH ₄) ₂ Cr ₂ O ₇
"	6.79	46.38	"	"	46.82	6.602	"
"	5.09	49.30	"	"	37.79	18.10	"
"	4.705	61.68	"	"	31.89	25.44	"
"	4.248	59.66	" + Na ₂ Cr ₂ O ₇	"	28.82	30.36	"
"	0.0	62.0	Na ₂ Cr ₂ O ₇	"	25.57	35.87	"
20	26.23	0.0	(NH ₄) ₂ Cr ₂ O ₇	"	24.92	36.99	"
"	15.41	25.42	"	"	20.21	43.03	"
"	6.269	58.13	"	"	16.405	57.27	"
"	6.179	61.38	" + Na ₂ Cr ₂ O ₇	"	16.02	59.21	"
"	0.0	65.20	Na ₂ Cr ₂ O ₇	"	16.05	59.28	"
50	42.03	0.0	(NH ₄) ₂ Cr ₂ O ₇	"	15.20	60.74	"
"	19.55	36.74	"	"	14.94	64.66	" + Na ₂ Cr ₂ O ₇
"	12.61	54.41	"	"	1.225	76.43	Na ₂ Cr ₂ O ₇
"	9.467	64.06	" + Na ₂ Cr ₂ O ₇	"	0.0	77.7	"
"	0.0	71.3	Na ₂ Cr ₂ O ₇				

AMMONIUM Boro FLUORIDE NH₄3BF₃.

F

100 gms. H₂O dissolve 25 gms. NH₄3BF₃ at 16° and about 97 gms. at the b. pt. (Stolba - Chem-Techn. Cent. Auz. 7 459)AMMONIUM Hafnium FLUORIDE (NH₄)₂HfF₆.100 gms. sat. solution of Ammonium Hafnium Fluoride in Water contain 26.0 gms. (NH₄)₂HfF₆ at 20°. (v. Hevesy, 1923.)AMMONIUM Silico FLUORIDE (NH₄)₂SiF₆.100 gms. H₂O dissolve 18.5 gms. (NH₄)₂SiF₆ at 17.5° (d = 1.096) (Stolba, 1877.)AMMONIUM Titanium FLUORIDE (NH₄)₂TiF₆.100 cc H₂O dissolve 25.0 gms. (NH₄)₂TiF₆ at 20-22°.100 cc 98% C₂H₅OH dissolve 0.004 gm. (NH₄)₂TiF₆ at 20-22°.

(Ginsberg, 1932.)

AMMONIUM IODIDE NH_4I .SOLUBILITY IN WATER.
(Smith and Eastlack, 1916.)SOLUBILITY IN AQUEOUS ALCOHOL AT 25°.
(Seidell, unpublished.)

t°.	Gms. NH_4I per 100 Gms. H_2O .	t°.	Gms. NH_4I per 100 Gms. H_2O .	Gms. $\text{C}_2\text{H}_5\text{OH}$ per 100 Gms. Solvent.	d ₂₀ of Sat. Sol.	Gms. NH_4I per 100 Gms. Sat. Sol.	Solvent
27.5 Eutec.	125.2	40	190.5	0	1.646	64.5	181.0
20	136	50	199.6	10	1.590	61.7	161.1
10	145	60	208.9	20	1.525	58.7	142.1
0	154.2	70	218.7	30	1.462	55.5	124.8
10	163.2	80	228.8	40	1.395	52	108.3
15	167.8	100	250.3	50	1.320	48	92.3
20	172.3	120	273.6	60	1.250	43.8	77.0
25	176.8	140	299.2	70	1.168	39	64
30	181.4			80	1.094	33.3	49.0
				90	1.013	27.5	37.0
				100	0.929	20.8	26.3

EQUILIBRIUM IN THE SYSTEM AMMONIUM IODIDE, ANTIMONY
IODIDE AND WATER.

(Francois and Delvaux, 1930.)

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The results are given only in the form of a diagram from which the following approximate values have been taken.

t°	Gms. per 100 gms. H_2O NH_4I	Gms. per 100 gms. H_2O SbI_3	Solid Phase	t°	Gms. per 100 gms. H_2O NH_4I	Gms. per 100 gms. H_2O SbI_3	Solid Phase
11	164	0	NH_4I	35	225	125	4.1.3
"	180	35	"	"	240	150	" + 2.1.2
"	195	62	" + 4.1.3	"	190	125	2.1.2
"	190	85	4.1.3	50	200	0	NH_4I
"	192	110	" + ?	"	215	50	"
"	170	120	2.1.2 + ?	"	245	100	"
"	140	110	2.1.2	"	265	135	" + 4.1.3
20	172	0	NH_4I	"	265	155	2.1.2 + "
"	195	40	"	"	200	130	2.1.2
"	210	70	" + 4.1.3	75	223	0	NH_4I
"	205	100	4.1.3	"	245	50	"
"	215	145	" + ?	"	270	100	"
"	210	150	2.1.2 + ?	"	290	145	" + 4.1.3
"	185	130	2.1.2	"	290	155	2.1.2 + "
35	186	0	NH_4I	"	250	135	2.1.2
"	205	50	"	"	150	110	"
"	235	95	" + 4.1.3				

4.1.3 = $4\text{NH}_4\text{I} \cdot \text{SbI}_3 \cdot 3\text{H}_2\text{O}$; 2.1.2 = $2\text{NH}_4\text{I} \cdot \text{SbI}_3 \cdot 2\text{H}_2\text{O}$.

The SbI_3 end of the curves could not be determined on account of hydrolysis.

SOLUBILITY OF AMMONIUM IODIDE IN LIQUID AMMONIA.

t°	Gms. NH ₄ I per 100:		t°	Gms. NH ₄ I per 100:	
	cc NH ₃	gms. NH ₃		cc NH ₃	gms. NH ₃
-50.0	62.1	— (1)	-38.6	69.2	— (1)
-47.5	63.3	— (1)	-35.3	71.2	— (1)
-45.2	64.6	— (1)	0.0	—	338.6 (2)
-42.0	66.7	— (1)	+25.0	—	368.5 (3)

(1) Scherer, 1931; (2) Linhard and Stephan, 1933, 1934; (3) Hunt and Boncyk, 1933.

100 gms. liquid Sulfur Dioxide (SO₂) dissolve 8.4 gms. NH₄I at 0°. (Jander and Wickert, 1936; Jander and Ruppolt, 1937.)

Determinations of the vapor pressure - temperature relations in the system NH₄I + SO₂ are given by Foote and Fleischer, 1931.

Data for equilibrium in the systems NH₄I + I + C₆H₆ and NH₄I + I + C₆H₅CH₃ are given by Foote and Bradley, 1933. The results show that no compound with the solvent occurs but only the binary tri iodide, NH₄I₃, which is stable over a wide range of iodine concentrations. Since NH₄I is practically insoluble in benzene and in toluene the authors analytical values are for the percentages of iodine in solution at each invariant point.

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AMMONIUM IODIDE NH₄I.

Tetra methyl and Tetra ethyl AMMONIUM IODIDES (CH₃)₄NI and (C₂H₅)₄NI.

SOLUBILITY OF EACH IN ETHYL URETHAN AT 60°. (Stuckgold, 1917.)

Compound.	Formula.	Gms. compd. per 100 cc. sat. sol.
Ammonium Iodide.....	NH ₄ I	9.00
Tetramethyl Ammonium Iodide..	(CH ₃) ₄ NI	0.15
Tetraethyl Ammonium Iodide....	(C ₂ H ₅) ₄ NI	1.63

SOLUBILITY OF TETRA ETHYL AMMONIUM IODIDE IN SEVERAL SOLVENTS.

(Bjerrum and Josefowicz, 1932.)

Solvent	Formula	t°	d. of sat. sol.	Gms. N(C ₂ H ₅) ₄ I per 100 gms. sat. sol.
Water	H ₂ O	20	1.0846	27.50
"	"	35	1.1227	39.55
Methyl Alcohol	CH ₃ OH	20	0.8277	9.05
"	"	35	0.8430	16.14
Ethyl "	C ₂ H ₅ OH	20	0.7937	0.914
"	"	35	0.7848	1.86
Acetone	(CH ₃) ₂ CO	20	0.7903	0.198
"	"	35	0.7738	0.250

Tetra-Ethyl AMMONIUM IODIDE N(C₂H₅)₄I.

SOLUBILITY IN SEVERAL SOLVENTS.

(Walden — Z. physik. Chem. 55, 698, '06.)

Solvent.	Formula.	t°.	Sp. Gr. of Solution.	Gms. N(C ₂ H ₅) ₄ I per 100.	
				cc. Solution.	Gms. Solution.
Water	H ₂ O	0	1.0470	16.31	15.58
Water	H ₂ O	25	1.1021	36.33 (35.5)	32.9
Methyl Alcohol	CH ₃ OH	0	0.8326	3.7-4.3	4.44
Methyl Alcohol	CH ₃ OH	25	0.8463	10.5 (10.7)	12.29
Ethyl Alcohol	C ₂ H ₅ OH	0	0.7928	0.348	0.439
Ethyl Alcohol	C ₂ H ₅ OH	25	0.7844	0.98 (0.88)	1.113
Glycol	(CH ₂ OH) ₂	0	1.1039	3.27	2.97
Glycol	(CH ₂ OH) ₂	25	1.0904	7.63 (7.55)	7
Acetonitrile	CH ₃ CN	0	0.8163	2.24	2.74
Acetonitrile	CH ₃ CN	25	0.7920	2.97 (3.54)	3.74
Propionitrile	CH ₃ CH ₂ CN	0	0.8059	0.618	0.767
Propionitrile	CH ₃ CH ₂ CN	25	0.7830	0.81-1.01	0.99
Benzonitrile	C ₆ H ₅ CN	25	...	0.467	0.451
Methyl Sulphocyanide	CH ₃ SCN	25	1.0828	4.40	4.06
Ethyl Sulphocyanide	C ₂ H ₅ SCN	25	1.0012	0.475	0.47
Nitro Methane	CH ₃ NO ₂	0	1.1658	3.59	3.004
Nitro Methane	CH ₃ NO ₂	25	1.1476	5.38-6.27	4.72
Nitroso Dimethylene	(CH ₂) ₂ N.NO	25	1.0059	2.67	2.66
Acetyl Acetone	CH ₃ COCH ₂ COCH ₃	25	...	0.268	..
Furfural	C ₄ H ₃ O.COII	0	1.1738	3.91	3.33
Furfural	C ₄ H ₃ O.COII	25	1.1692	5.33	4.55
Benzaldehyde	C ₆ H ₅ COH	25	...	0.43	...
Salicylaldehyde	C ₆ H ₄ .OH.COII	25	...	change- able-17.7	...
Anisaldehyde	C ₆ H ₄ .OCH ₃ .COII	25	...	0.59	...
Acetone	(CH ₃) ₂ CO	0	0.7991	0.174	0.218
Acetone	(CH ₃) ₂ CO	25	...	0.249	0.316
Ethyl Acetate	CH ₃ COOC ₂ H ₅	25	...	0.00039	..
Ethyl Nitrate	C ₂ H ₅ ONO ₂	25	1.0984	0.062	0.056
Benzoyl Ethyl Acetate	C ₆ H ₅ COCH ₂ COOC ₂ H ₅	25	1.1303	0.321	0.284
Dimethyl Malonate	CH ₂ (COOCH ₃) ₂	25	1.1335	0.040	0.035
Methyl Cyan Acetate	CH ₂ CNCOOCH ₃	0	1.1341	1.82	1.605
Methyl Cyan Acetate	CH ₂ CNCOOCH ₃	25	...	2.83	...
Ethyl Cyan Acetate	CH ₂ CNCOOC ₂ H ₅	0	1.0760	1.057	0.981
Ethyl Cyan Acetate	CH ₂ CNCOOC ₂ H ₅	25	1.0607	1.71	1.41
Nitrobenzene	C ₆ H ₅ NO ₂	25	...	0.504	0.422
Acetophenone	C ₆ H ₅ .COCH ₃	..	...	0.13	0.127
Amyl Alcohol	C ₅ H ₁₁ OH	..	...	0.071	0.080
Paraldehyde	(C ₂ H ₄ O) ₃	0.036	0.037
Methyl Formate	HCOOCH ₃	0.031	0.032
Bromobenzene	C ₆ H ₅ Br	0.009	0.006

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(Walden — Z. physik. Chem. 61, 635, 1907-'08.)

Tetra Methyl **AMMONIUM IODIDE** N(CH₃)₄I.

SOLUBILITY IN SEVERAL SOLVENTS.

(Walden — Z. physik. Chem. 55, 708, '06.)

Solvent.	Formula.	t°.	Sp. Gr. of Solution.	Gms. N(CH ₃) ₄ I per 100.	
				cc. Solution.	Gms. Solution.
Water	H ₂ O	0	1.0188	2.01	1.97
Water	H ₂ O	25	1.0155	5.31-5.89	5.22
Methyl Alcohol	CH ₃ OH	0	0.8025	0.18-0.22	0.22
Methyl Alcohol	CH ₃ OH	25	0.7920	0.38-0.42	0.48
Ethyl Alcohol	C ₂ H ₅ OH	25	0.7894	0.09	...
Glycol	(CH ₂ OH) ₂	0	...	1.014	...
Glycol	(CH ₂ OH) ₂	25	1.0678	0.240	0.224
Acetonitril	CH ₃ CN	25	...	0.650	...
Nitro Methane	CH ₃ NO ₂	0	1.1387	0.25-0.32	0.22
Nitro Methane	CH ₃ NO ₂	25	1.1285	0.34-0.38	0.21
Acetone	(CH ₃) ₂ CO	0	...	0.118	...
Acetone	(CH ₃) ₂ CO	25	...	0.187	...
Salicyl Aldehyde	C ₆ H ₄ .OH.CO.H	0	1.1492	0.302	0.263
Salicyl Aldehyde	C ₆ H ₄ .OH.CO.H	25	1.1379	0.510	0.484

Very exact determinations of the solubility of tetra methyl ammonium iodide in aqueous solutions of KOH and of NH₄OH at 25° are given by Hill (1917).

Tetra Propyl **AMMONIUM IODIDE** N(C₃H₇)₄I.

SOLUBILITY IN SEVERAL SOLVENTS.

(Walden — Z. physik. Chem. 55, 709, '06.)

Solvent.	Formula.	t°.	Sp. Gr. of Solution.	Gms. N(C ₃ H ₇) ₄ I per 100.	
				cc. Solution	Gms. Solution.
Methyl Alcohol	CH ₃ OH	0	0.9756	40.92	41.94
Methyl Alcohol	CH ₃ OH	25	1.0187	56.42	55.37
Ethyl Alcohol	C ₂ H ₅ OH	0	0.8349	6.5-6.8	8.14
Ethyl Alcohol	C ₂ H ₅ OH	25	0.8716	19.88-20.29	23.28
Acetonitrile	CH ₃ CN	0	0.8553	13.03	15.24
Acetonitrile	CH ₃ CN	25	0.8584	18.69	21.77
Propionitrile	C ₂ H ₅ CN	0	0.8280	6.37	7.66
Propionitrile	C ₂ H ₅ CN	25	0.8191	9.65	10.29
Benzonitrile	C ₆ H ₅ CN	25	1.0199	8.44	8.35
Nitro Methane	CH ₃ NO ₂	0	1.181	14.79	12.52
Nitro Methane	CH ₃ NO ₂	25	1.158	22.24	19.21
Nitro Benzene	C ₆ H ₅ NO ₂	25	1.193	5.71	4.79
Benzaldehyde	C ₆ H ₅ COH	0	1.0581	7.06	6.67
Benzaldehyde	C ₆ H ₅ COH	25	1.0549	9.87	9.35
Anisaldehyde	C ₆ H ₅ .OCH ₃ .COH	0	1.1114	5.60	5.04
Anisaldehyde	C ₆ H ₅ .OCH ₃ .COH	25	1.1004	6.75	6.14
Salicylaldehyde	C ₆ H ₄ .OH.CO.H	25	...	39.28	...
Ethyl nitrite	C ₂ H ₅ NO ₂	0	1.1207	0.522	0.466
Ethyl nitrite	C ₂ H ₅ NO ₂	25	1.1025	0.653	0.592
Dimethyl Malonate	CH ₂ (COOCH ₃) ₂	0	1.1532	0.298	0.259
Dimethyl Malonate	CH ₂ (COOCH ₃) ₂	25	1.1345	0.320	0.282
Acetone	(CH ₃) ₂ CO	0	0.8259	2.692	4.65
Acetone	(CH ₃) ₂ CO	25	0.8049	3.944	4.90
Ethyl Acetate	CH ₃ COOC ₂ H ₅	25	0.8975	0.0063	0.007
Ethyl Bromide	C ₂ H ₅ Br	25	...	...	0.187

(Walden — Z. physik. Chem. 61, 639, 1907-'08.)

SOLUBILITY OF TETRA AMYL, TETRA ETHYL AND TETRA α PROPYL AMMONIUM IODIDES IN WATER AND IN CHLOROFORM AT 25°. (Peddle and Turner, 1913.)

Solvent.	Gms. Each Salt (Determined Separately), per 100 Gms. Solvent.		
	N(C ₄ H ₉) ₄ I.	N(C ₂ H ₅) ₄ I.	α N(C ₃ H ₇) ₄ I.
Water	0.74	45	18.64
CHCl ₃	210.8	1.55	54.56

Freezing-point data for mixtures of tetra methyl ammonium iodide and iodine, and for phenyltrimethyl ammonium iodide and iodine are given by Olivari (1908).

AMMONIUM IODATE NH₄IO₃.

SOLUBILITY IN AQUEOUS IODIC ACID AT 30°. (Meerburg, 1905.)

10

Gms. per 100 Gms. Sat. Sol.		Solid Phase.	Gms. per 100 Gms. Sat. Sol.		Solid Phase.
HIO ₃ .	NH ₄ IO ₃ .		HIO ₃ .	NH ₄ IO ₃ .	
0	4.20	NH ₄ IO ₃	24	0.62	NH ₄ IO ₃ ·2HIO ₃
2.54	3.89	"	44.43	0.39	"
4.52	3.83	" + NH ₄ IO ₃ ·2HIO ₃	76.35	0.31	" + HIO ₃
6.57	1.94	NH ₄ IO ₃ ·2HIO ₃	76.70	0	HIO ₃

AMMONIUM Per IODATE NH₄IO₄.

100 gms. H₂O dissolve 2.7 gms. salt at 16°, $d_{40} = 1.078$.

(Barker, 1908.)

AMMONIUM PERMANGANATE NH₄MnO₄.

100 parts water dissolve approximately 8 parts of NH₄MnO₄ at 15°. (Aschoff.)

AMMONIUM MOLYBDATES

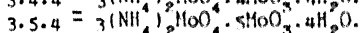
EQUILIBRIUM IN THE SYSTEM AMMONIA, MOLYBDENUM TRI OXIDE AND WATER AT 25°.

MoO

(Foote and Bradley, 1956.)

The study of this system is rendered difficult by the slowness with which equilibrium is reached at the molybdenum end of the diagram and the colloidal character and high concentration of the solutions at the other end. The mixtures were prepared from the well crystalline ammonium para molybdate, $3(\text{NH}_4)_2\text{MoO}_4 \cdot 4\text{H}_2\text{O}$, and either ammonia or MoO₃, and rotated for periods of several weeks to several months. Both the saturated solutions and solid phases were analyzed.

Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase
NH ₃	MoO ₃		NH ₃	MoO ₃	
5.72	26.94	3.4.4	3.39	17.54	3.5.4
4.40	21.97	"	3.02	14.75	"
4.09	20.86	"	2.56	12.71	"
3.60	19.45	"	2.27	11.25	"
3.44	19.03	"	1.86	9.54	"
3.56	18.87	" + 3.5.4	1.35	7.00	"



The authors call attention to the improbability of the existence at 25° of all of the five ammonium molybdates, mentioned in the literature, which contain a larger proportion of MoO₃ than present in the above two compounds.

AMMONIUM Tri and Tetra MOLYBDATES (NH₄)₂(O.3MoO₃.H₂O and (NH₄)₂O.4MoO₃.2H₂O.

SOLUBILITY OF EACH IN WATER AT 15°. (Travers and Malaprade, 1926.)

Compound.	Formula.	Gms. anhydrous compd. per liter.
Ammonium trimolybdate...	(NH ₄) ₂ O.3MoO ₃ .H ₂ O	14.0
" tetramolybdate.	(NH ₄) ₂ O.4MoO ₃ .2H ₂ O	9.5

AMMONIUM Tetra MOLYBDATE (NH₄)₂O.4MoO₃.2H₂O.

100 gms. H₂O dissolve 3.52 gms. salt at 15° (*d* = 1.03), 3.67 gms. at 18° (*d* = 1.04) and 4.60 gms. at 32° (*d* = 1.05). (Wempe, 1912.)

AMMONIUM Phospho MOLYBDATE (NH₄)₃PO₄.14MoO₃.4H₂O.

SOLUBILITY IN WATER AND AQUEOUS SOLUTIONS AT 15°. (de Lucchi, 1910.)

Solvent.	Gms. Salt per 1000 Gms. Solvent.
Water	0.238
5 per cent aqueous NH ₄ NO ₃ solution	0.137
1 per cent aqueous HNO ₃ solution	0.203

AMMONIUM Tri NITRIDE NH₄N₃.

SOLUBILITY OF AMMONIUM TRINITRIDE IN WATER.

(Frost, Cothran and Browne, 1933.)

t°	Gms. NH ₄ N ₃ per 100 gms. sat. sol.	Solid Phase
0	13.8	NH ₄ N ₃
20	20.16	"
40	37.07	"

Pressure-temperature-concentration relations in the binary system ammonium tri nitride-ammonia are given by Howard Jr., Friederichs and Browne, 1934. The solvates, ammonium trinitride diammonate, NH₄N₃.2NH₃, and ammonium trinitride penta ammonate, NH₄N₃.5NH₃, were obtained as white crystalline solids. The diammonate undergoes inversion into ammonous salt at -9° and the pentaammonate undergoes inversion into the diammonate at -71°. The eutectic is located at -87° and 76% ammonia.

Tetra methylAMMONIUM TriNITRIDE N(CH₃)₄N₃.

APPROXIMATE SOLUBILITY IN SEVERAL SOLVENTS AT 20°. (Friedlander, 1918.)

Solvent.	Gms. N(CH ₃) ₄ N ₃ per 100 gms. sat. sol.	Solvent.	Gms. N(CH ₃) ₄ N ₃ per 100 gms. sat. sol.
Water.....	50.0	Benzene.....	0.4
Ethyl alcohol.....	5.0	Chloroform.....	0.1
Methyl alcohol.....	2.0	Ethyl ether.....	0.05

Excess of the salt in contact with carbon tetrachloride forms two layers, the lower of which contains 0.5 gm. N (CH₃)₄N₃ per 100 cc.

AMMONIUM NITRITE NH_4NO_2 .SOLUBILITY OF AMMONIUM NITRITE IN WATER, DETERMINED
BY THE FREEZING-POINT METHOD.

(Bureau, 1937.)

t°	Gms. NH_4NO_2 per 100 gms. sat. sol.	Solid Phase	t°	Gms. NH_4NO_2 per 100 gms. sat. sol.	Solid Phase
-5.2	10.2	Ice	-11.15	50.05	NH_4NO_2
-10.5	17.95	"	+ 1.4	56.0	"
-12.4	21.3	"	19.15	64.3	"
-21.75	35.0	"	33.45	75.0	"
-27.9 (ButeC)	42.5	" + NH_4NO_2			

Above 33° the saturated solutions decompose rapidly.AMMONIUM NITRATE NH_4NO_3 .

SOLUBILITY IN WATER.

(Schwarz — Ostwald's Lehrbuch, 2d ed. p. 425; Muller and Kaufmann — Z. physik. Chem.
42, 497, '01-'02.)

t°	Sp. Gr. Solution.	G. Mols. NH_4NO_3 per 100 Mols. H_2O .	Gms. NH_4NO_3 per 100 Gms.		Solid Phase.
			Solution.	Water.	
0	...	26.63	54.19	118.3	NH_4NO_3 rhomb. β
12.2	1.2945	34.50	60.53	153.4	"
20.2	1.3116	43.30	65.80	192.4	"
25.0	1.3197	48.10	68.17	214.2	"
30.0	1.3299	54.40	70.73	241.8	"
32.1	1.3344	57.00	71.97	256.9	NH_4NO_3 rhomb. β + rhomb. α
35.0	1.3394	59.80	72.64	265.8	NH_4NO_3 rhomb. α
40.0	1.3464	66.80	74.82	297.0	"
50.0	...	77.41	77.49	344.0	"
60.0	...	94.73	80.81	421.0	"
70.0	...	112.30	83.32	499.0	"
80.0	...	130.50	85.25	580.0	"
90.0	...	166.50	88.08	740.0	NH_4NO_3 rhombohedral?
100.0	...	196.00	89.71	871.0	"

SOLUBILITY OF AMMONIUM NITRATE IN WATER.

Rodenbush, 1918; Early and Lowry, 1919; Millican, Joseph and Lowry, 1922. Kazantzov, 1923, 1925; Mondain Monval, 1923, 1925; Cohen and Bredée, 1925.)

The various determinations were plotted on cross section paper and the following values taken from the curve. The determinations of M. J. and L. were made by the sealed tube method and also by use of a Beckmann apparatus. The results of C and B are claimed to be accurate to 0.02-0.03 per cent, and nearer correct than those of M. M.

t°.	Gms. NH ₄ NO ₃ per 100 gms. sat. sol.	Solid Phase.	t°.	Gms. NH ₄ NO ₃ per 100 gms. sat. sol.	Solid Phase.
— 5	12.7 ^a	Ice	40.0	73.7 ^b (74.2) ^c	NH ₄ NO ₃ III
— 10	26.0	"	45.0	75.34 (76.1)	"
— 15	38.6	"	50.0	77.0 (77.8)	"
— 16.67 (Eutec.)	42.8	" + NH ₄ NO ₃ IV	60.0	80.7 (83.5)	"
— 10.0	47.7	NH ₄ NO ₃ IV	70.0		"
— 5.0	51.2	"	80	86.4 ^c	"
0.0	54.23 ^b	"	84.2 (tr. pt.)	87.0	" + NH ₄ NO ₃ x
+ 5.0	57.23 (59.0) ^c	"	90	89.0	NH ₄ NO ₃ x
10.0	60.05 (61.5)	"	100	91.4	"
15.0	62.76 (63.8)	"	110	93.4	"
20.0	65.24 (66.0)	"	120	95.0	"
25.0	67.63 (68.1)	"	125 (tr. pt.)	95.5	" + NH ₄ NO ₃ y
30.0	69.90 (70.1)	"	130	96.5	NH ₄ NO ₃ y
32.0	70.77 (71.0)	"	140	97.5	"
32.27 (tr. pt.)	71.0 (71.0)	" + NH ₄ NO ₃ III	150	98.7	"
33.0	71.12 (71.2)	NH ₄ NO ₃ III	169.6	100.0	"
35.0	71.6 (72.0)	"			

NO

* Determinations of Rodenbush. ^b Determinations of Cohen and Bredée. ^c Determinations of Millican, Joseph and Lowry. NH₄NO₃ IV corresponds to the α rhombic form and NH₄NO₃ III corresponds to the β rhombic form of other writers. Millican, Joseph and Lowry designate as γ the form of the salt which is stable between 32° and 84°.

SOLUBILITY OF AMMONIUM NITRATE IN WATER.

(Kurnakow and Rawitsch, 1933; results in parentheses, Nikitina, 1933.)

t°	Gms. NH ₄ NO ₃ per 100 gms. sat. sol.	Solid Phase	t°	Gms. NH ₄ NO ₃ per 100 gms. sat. sol.	Solid Phase
— 16.9	42.30	Ice + NH ₄ NO ₃ α rhomb.	55	79.40	NH ₄ NO ₃ rhomboedr.
— 10.0	47.24	" + NH ₄ NO ₃ β rhomb.	60	(80.41)	"
— 16 tr. pt.	—	α rhomb + β rhomb.	80	85.68 (85.44)	"
0	54.94 (54.2)	NH ₄ NO ₃ β rhomb.	84 tr. pt.	—	" + cubic
20	(64.0)	"	86	86.89	NH ₄ NO ₃ cubic
25	68.19	"	98	(91.15)	" rhomboedr.
33.3 tr. pt.	—	β rhomb + rhomboedr.	100	89.41	NH ₄ NO ₃ cubic
35	72.21	NH ₄ NO ₃ rhomboedr.	125 tr. pt.	—	cubic + tetragonal
40	(74.64)	"	130	95.64	tetragonal

The following results for the solubility of ammonium nitrate in water at temperatures above 100°, determined by the synthetic method, are by Benrath, Gjedebø, Schiffrs and Wunderlich, 1937.

t°	Gms. NH ₄ NO ₃ per 100 gms. sat. sol.	t°	Gms. NH ₄ NO ₃ per 100 gms. sat. sol.	t°	Gms. NH ₄ NO ₃ per 100 gms. sat. sol.
101	89.8	123	94.1	147	97.7
112	91.7	133	95.6	159	99.0
119	93.5	140	96.5	170 m. pt.	100.0

Data for the Solubility of Ammonium Nitrate in Water at 25° and under pressures up to 12 kilobars are given by Adams and Gibson, 1932. The Solubility decreases continually from 67.6 percent at atmospheric pressure to 43.6% at 5 kilobars pressure, 29.7% at 10 kilobars and 25.3% at 12 kilobars, the eutectic pressure.

SOLUBILITY OF AMMONIUM NITRATE IN NITRIC ACID.

(Groschuff — Ber. 37, 1488, '04.)

Determinations by the "Synthetic Method,"

t°.	Gms. NH ₄ NO ₃ per 100 Gms. Sol.	Mols. NH ₄ NO ₃ per 100 Mols. HNO ₃ .	Solid Phase.	t°.	Gms. NH ₄ NO ₃ per 100 Gms. Sol.	Mols. NH ₄ NO ₃ per 100 Mols. HNO ₃ .	Solid Phase.
8	21.1	21.1	NH ₄ NO ₃ ·2HNO ₃	11.0	51.7	84.3	NH ₄ NO ₃ ·HNO ₃
23	28.7	31.6	" a	12.0	54.7	95.1	" labil
29.5 m.pt.	38.8	50.0	"	11.5	57.6	108.0	" b
27.5	44.6	63.4	" b	11.5	54.0	92.4	NH ₄ NO ₃ labil.
23.5	49.4	76.8	"	17.0	54.7	95.1	" stabil
17.5	54.0	92.4	"	27.0	56.2	101.0	"
16.5	54.3	93.5	"	49.0	60.4	120.0	"
4.0	45.8	66.7	NH ₄ NO ₃ ·HNO ₃ labil	79.0	68.1	168.0	"

a = solution in HNO₃,b = solution in NH₄NO₃.

SOLUBILITY OF AMMONIUM TRI-NITRATE IN WATER.

(Groschuff)

t°.	Gms. NH ₄ NO ₃ per 100 Gms. Solution.	Gms. HNO ₃ per 100 Gms. Solution.	Mols. NH ₄ (NO ₃) ₃ per 100 Mols. H ₂ O	Mols. NH ₄ NO ₃ per 100 total Mols. Solution.	Solid Phase.
- 8	34.2	53.9	64.3	22	NH ₄ NO ₃ ·2HNO ₃
- 2.5	34.8	54.8	75.1	23.1	"
+ 3	35.4	55.8	90	24.3	"
8.5	36.6	56.9	113	25.7	"
19.5	37.4	58.9	225	29	"
25	38.1	60	450	31	"
29.5 m. pt.	38.8	61.2	∞	33	"

* or NH₄NO₃·3HNO₃.

SOLUBILITY OF AMMONIUM NITRATE IN AQUEOUS SOLUTIONS OF NITRIC ACID.

(Kazantzov, 1923, 1925.)

Saturation was obtained by constant agitation for periods of 1 to 2 hours. Carefully purified materials were used.

Results at 0°.		Results at 15°.		Results at 30°.		Results at 75°.	
HNO ₃ .	Gms. per 100 gms. sat. sol.	NH ₄ NO ₃ .	Gms. per 100 gms. sat. sol.	HNO ₃ .	Gms. per 100 gms. sat. sol.	HNO ₃ .	Gms. per 100 gms. sat. sol.
0.0	54.3	0.0	62.4	0.0	70.2	0.0	84.1
9.2	43.5	0.7	61.1	3.5	65.5	12.8	73.7
15.5	38.4	2.8	59.1	8.6	60.9	16.0	71.8
21.0	34.5	7.7	53.3	10.6	58.8	26.3	67.5
24.0	32.8	9.0	52.0	14.4	55.6	31.6	66.8
27.0	31.9	16.4	45.7	16.7	53.1		
30.0	31.1	21.7	42.2	20.8	51.5		
33.2	31.0	27.1	40.9	22.1	50.0		
36.2	32.1	31.5	39.2	26.4	48.5		
39.1	33.2	36.7	39.9	30.0	47.5		
41.4	34.0	39.0	40.8	37.5	48.6		
45.8	39.5	44.0	46.8	40.1	51.0		
47.4	48.2	45.0	52.5	42.2	55.6		

20°
(Nichols, Howes et. al., 1919.)

0.0	65.63
3.98	60.16
8.81	55.95
14.65	51.17
21.46	46.35
28.33	43.35

SOLUBILITY OF AMMONIUM NITRATE IN AMMONIA.

(Kuriloff—Z. phys. Chem. 25, 109, '98.)

t°.	Gms. NH ₄ NO ₃ .	Gms. NH ₃ .	Mols. NH ₄ NO ₃ per 100 Mols. NH ₄ NO ₃ + NH ₃ .	t°	Gms. NH ₄ NO ₃ .	Gms. NH ₃ .	Mols. NH ₄ NO ₃ per 100 Mols. NH ₄ NO ₃ + NH ₃ .
-80	0	100	0.0	33.3	0.9358	0.2352	45.9
-60	1.3918	4.4327	6.25	35.9	0.7746	0.1857	47.0
-44.5	0.9526	1.2457	13.9	68.8	4.2615	0.7747	53.8
-30	0.8308	0.3700	32.3	94.0	0.6439	0.0665	67.3
-10.5	0.9675	0.3515	36.9	190.8	0.7578	0.0588	74.2
0	0.7600	0.2607	38.3	168.0	...	...	100.0

t° = temperature of equilibrium between solution and solid phase

SOLUBILITY OF AMMONIUM NITRATE IN AQUEOUS SOLUTIONS OF AMMONIA AT 25°.

(Hunt, 1932.)

Gms. H ₂ O per 100 gms. NH ₃ + H ₂ O	Gms. NH ₄ NO ₃ per 100 gms. solvent	Gms. H ₂ O per 100 gms. NH ₃ + H ₂ O	Gms. NH ₄ NO ₃ per 100 gms. solvent
0	390.0	13.2	351.9
1.78	383.7	15.9	337.4
2.80	381.0	18.6	331.8
3.40	378.6	21.8	316.8
4.82	372.8	47.5	247.0
6.86	368.6	68.0	220.0
10.1	354.7	100.	214.2
12.1	352.1		

SOLUBILITY OF AMMONIUM NITRATE IN AQUEOUS SOLUTIONS OF AMMONIUM SULFATE AND VICE VERSA.

(Massink, 1916, 1917.)

Results at 0°.
(de Waal, 1910.)Results at 30°.
(Schreinemakers and Harnen, 1910.)Results at 70°.
(de Waal, 1910.)

Gms. per 100 Gms. Sat. Sol.	Solid Phase.	Gms. per 100 Gms. Sat. Sol.	Solid Phase	Gms. per 100 Gms. Sat. Sol.	Solid Phase.
NH ₄ NO ₃ (NH ₄) ₂ SO ₄		NH ₄ NO ₃ (NH ₄) ₂ SO ₄		NH ₄ NO ₃ (NH ₄) ₂ SO ₄	
54.19	0	70.1	0	84.03	0
49.12	0	67.63	2.38	81.38	2.41
45.99	9.53	66.03	3.46	81.01	2.45
31.61	19.5	63.84	4.06	80.25	2.68
30.87	20.43	58.06	8.22	76.01	3.06
31.04	20.4	52.75	11.42	73.48	5.14
29.81	21.33	49.80	13.27	71.58	5.82
29.58	41.64	37.20	19.48	70.15	6.71
5.61	37.89	10.91	28.83	11.10	40.81
0	41.4	12.05	34.7	0	47.81
		0	44.1		

1.3 = (NH₄)₂SO₄.3NH₄NO₃.1.2 = (NH₄)₂SO₄.2NH₄NO₃.

Later determinations by Janecke, Bissner and Brill show that the only double salt formed at temperatures between 0° and 100° is the 1.2 salt, (NH₄)₂SO₄.2NH₄NO₃. The results are presented in the form of a diagram but the numerical values are not given. The authors also give the m. pt. diagram for the system NH₄NO₃ + (NH₄)₂SO₄ but not the numerical results.

SOLUBILITY OF AMMONIUM NITRATE IN AQUEOUS SOLUTIONS OF
AMMONIUM ACID SULFATE AT 25°.

(Wöhler and Schäffer, 1925.)

Gms. per 100 gms. sat. sol.		Solid Phase.	Gms. per 100 gms. sat. sol.		Solid Phase.
NH ₄ NO ₃	NH ₄ H ₂ SO ₄		NH ₄ NO ₃	NH ₄ H ₂ SO ₄	
59.0	13.9	NH ₄ NO ₃	30.1	51.1	NH ₄ NO ₃ .NH ₄ H ₂ SO ₄
52.5	25.5	"	27.3	58.8	"
45.5	36.6	"	23.3	62.5	NH ₄ H ₂ SO ₄
35.8	47.9	NH ₄ NO ₃ .NH ₄ H ₂ SO ₄	16.9	66.1	"
22.3	49.1	"	8.2	69.5	"

The authors also give the following results for the solubility of the double salt NH₄NO₃.NH₄H₂SO₄ in water at different temperatures.

t.....	20.	30.	40.	50.	60.
Gms. NH ₄ NO ₃ .NH ₄ H ₂ SO ₄ per 100 gms. sat. sol.	82.9	84.6	86.9	89.3	92.6

EQUILIBRIUM IN THE SYSTEM : AMMONIUM NITRATE + AMMONIUM THIOCYANATE
+ AMMONIA. (Foote and Brinkley, 1921.)

The mixtures were shaken at constant temperatures and the saturated solutions analyzed by titrating the ammonia, using Congo Red as indicator, and the thiocyanate by the Volhard method. The NH₄NO₃ was estimated by difference.

Results at 0°.		Results at 10°.		Results at 20°.		Solid Phase at each temperature
NH ₃	NH ₄ CNS.	NH ₃	NH ₄ CNS.	NH ₃	NH ₄ CNS.	
22.88	77.12	22.70	77.30	21.35	78.65	NH ₄ CNS
20.96	69.88	20.11	71.49	19.59	75.72	"
19.60	64.95	17.85	64.66	18.12	70.24	"
19.05	61.72	17.28	61.64	15.20	60.00	" + NH ₄ NO ₃
19.97	59.97	18.52	56.37	17.73	54.37	NH ₄ NO ₃
23.70	44.58	21.87	44.53	20.37	42.38	"
24.70	37.15	23.06	34.53	21.20	29.64	"
24.75	24.55	23.32	21.70	21.15	19.47	"
24.22	9.64	22.55	8.80	21.13	14.20	"
23.13	0.0	21.91	0.0	20.55	0.00	"

SOLUBILITY OF AMMONIUM NITRATE IN PRESENCE OF SODIUM CHLORIDE.
(Rengade, 1917, 1922.)

Equimolecular mixtures of NH₄NO₃ + NaCl or of NaNO₃ + NH₄Cl were evaporated at gradually increasing temperatures and the solutions analyzed after the separation of NaCl and before the appearance of NH₄Cl, which could be easily distinguished by its crystalline form. The four ions were determined and the results arbitrarily expressed in terms of NH₄NO₃ + NaCl.

t°.	Gms. per 100 gms. H ₂ O.		t°.	Gms. per 100 gms. H ₂ O.		t°.	Gms. per 100 gms. H ₂ O.		
	NH ₄ NO ₃	NaCl		NH ₄ NO ₃	NaCl		NH ₄ NO ₃	NaCl	NaNO ₃
80°...	81	46	108°...	435	100	118°...	750	140	0
98°...	128	56	111°...	464	101	124°...	2,015	320	35
100°...	139	59	115°...	683	137	129°...	3,500	427	29

* These solutions prepared from equimolecular mixtures of NaNO₃ + NH₄Cl, and the others from equimolecular mixtures of NH₄NO₃ + NaCl. The results were intended for use in the industrial preparation of NH₄NO₃.

SOLUBILITY OF MIXTURES OF AMMONIUM NITRATE AND SODIUM NITRATE
IN WATER. (Mondain Monval, 1925.)

t°.	Gms. per 100 gms. H ₂ O.			t°.	Gms. per 100 gms. H ₂ O.		
	NaNO ₃	NH ₄ NO ₃	Solid Phase		NaNO ₃	NH ₄ NO ₃	Solid Phase
12.67....	68.4	150.4	NH ₄ NO ₃	9.9.....	74.0	140	NaNO ₃
18.48....	68.4	176.0	"	13.13....	76.68	140	"
100 gms. H ₂ O dissolve 1233 gms. NH ₄ NO ₃ + 333 gms. NaNO ₃ at 100°.							
100 cc. Pyridine dissolve 22.88 gms. NH ₄ NO ₃ at 0°.							

(Wurmser, 1922.)
(Müller, R., 1924.)

RECIPROCAL SOLUBILITY OF AMMONIUM NITRATE AND SODIUM NITRATE IN
WATER AT 0°, 15° AND 30°.
(Fedotieff and Koltunoff, 1914)

t°.	Sp. Gr. Sol.	Gms. per 100 Gms. H ₂ O.		t°.	Sp. Gr. Sol.	Gms. per 100 Gms. H ₂ O.	
		NH ₄ NO ₃	NaNO ₃			NH ₄ NO ₃	NaNO ₃
0	1.354	0	73.33	15	1.420	155.3	75.38
0	1.407	105.5	66	15	1.405	156.1	60.76
0	1.264	118.4	0	15	1.364	150	36.50
15	1.375	0	83.9	15	1.350	160	27.79
15	1.386	24.03	81.21	15	1.330	162.3	17.63
15	1.392	42.81	79.34	15	1.298	167.4	0
15	1.401	64.6	78.06	30	1.401	0	96.12
15	1.417	110.9	75.81	30	1.450	220.8	88.31
15	1.428	152	75.35	30	1.320	232.0	0

NO

Later determinations of this system by Nikitina, 1933, gave the following results.

t°	Gms. per 100 gms. sat. sol.		Solid Phase	t°	Gms. per 100 gms. sat. sol.		Solid Phase
	NH ₄ NO ₃	NaNO ₃			NH ₄ NO ₃	NaNO ₃	
0	52.40	0.0	β rhomb NH ₄ NO ₃	60	80.41	0.0	α rhomb NH ₄ NO ₃
"	52.46	2.08	"	"	78.60	3.24	"
"	50.42	4.25	"	"	75.30	6.87	"
"	49.05	7.18	"	"	73.82	9.02	"
"	41.37	20.02	"	"	64.59	20.40	" + NaNO ₃
"	38.71	24.63	" + NaNO ₃	"	0.0	55.58	NaNO ₃
"	0.0	42.34	NaNO ₃	80	86.44	0.0	α rhomb NH ₄ NO ₃
10	64.0	0.0	β rhomb NH ₄ NO ₃	"	80.13	8.73	"
"	62.54	2.72	"	"	75.58	15.09	"
"	61.51	5.30	"	"	72.06	19.25	" + NaNO ₃
"	55.01	12.64	"	"	61.48	25.37	NaNO ₃
"	52.24	16.47	"	"	51.89	42.03	"
"	49.60	22.40	" + NaNO ₃	"	40.83	51.6	"
"	33.48	30.27	NaNO ₃	"	0.0	59.9	"
"	22.85	35.25	"	98	91.15	0.0	rhomboedr. NH ₄ NO ₃
"	10.95	41.34	"	"	88.89	3.78	"
"	0.0	46.80	"	"	86.89	5.38	"
40	74.64	0.0	α rhomb NH ₄ NO ₃	"	85.97	7.23	"
"	72.98	2.70	"	"	85.51	8.79	"
"	60.07	21.68	" + NaNO ₃	"	78.26	18.45	" + NaNO ₃
"	41.47	31.02	NaNO ₃	"	0.0	61.04	NaNO ₃
"	13.01	44.98	"				
"	0.0	51.30	"				

SOLUBILITIES OF MIXTURES OF AMMONIUM NITRATE AND OTHER SALTS.

(Rüdorf—Mulder.)

100 gms. H₂O dissolve 162.9 gms. NH₄NO₃ + 77.1 gms. NaNO₃ at 16° R.
 100 gms. H₂O dissolve 88.8 gms. NH₄NO₃ + 40.6 gms. KNO₃ at 9° M.
 100 gms. H₂O dissolve 101.3 gms. NH₄NO₃ + 6.2 gms. Ba(NO₃)₂ at 9° M

SOLUBILITY OF AMMONIUM NITRATE IN AQUEOUS SOLUTIONS OF LEAD NITRATE AT 10° AND AT 20° AND VICE VERSA.

(Malqueri, 1926.)

The authors results were plotted and the following results taken from the average curves.

Results at 10°

Gms. per 100	gms. sat. sol.	Solid	Gms. per 100	gms. sat. sol.	Solid
NH_4NO_3	$\text{Pb}(\text{NO}_3)_2$	Phase	NH_4NO_3	$\text{Pb}(\text{NO}_3)_2$	Phase
60.5	0.0	NH ₄ NO ₃	65.8	0.0	NH ₄ NO ₃
51.0	10.0	"	58.5	10.0	"
45.5	20.0	"	53.0	20.0	"
41.5	30.0	"	48.5	29.0	" + Pb(NO ₃) ₂
40.5	36.0	" + Pb(NO ₃) ₂	40.0	31.0	Pb(NO ₃) ₂
30.0	32.0	Pb(NO ₃) ₂	30	31.7	"
20.0	29.5	"	20	32.5	"
10.0	27.5	"	10	33.2	"
0.0	27.4	"	0	36.0	"

SOLUBILITY OF AMMONIUM NITRATE IN AQUEOUS SOLUTIONS OF LEAD NITRATE AT 25° AND VICE VERSA.

(Mill and Kaplan, 1936.)

Gms. per 100	gms. sat. sol.	Solid	Gms. per 100	gms. sat. sol.	Solid
NH_4NO_3	$\text{Pb}(\text{NO}_3)_2$	Phase	NH_4NO_3	$\text{Pb}(\text{NO}_3)_2$	Phase
68.17	0.0	NH ₄ NO ₃	36.92	32.61	Pb(NO ₃) ₂
56.15	18.04	"	28.75	33.65	"
49.00	29.44	" + Pb(NO ₃) ₂	16.28	34.02	"
48.47	29.63	Pb(NO ₃) ₂	12.35	33.99	"
44.58	30.79	"	0.0	37.17	"

SOLUBILITY OF AMMONIUM NITRATE IN AQUEOUS SOLUTIONS OF URANYL NITRATE AND VICE VERSA AT 25°

(Colani, 1927, 1928.)

Gms. per 100	gms. sat. sol.	Solid	Gms. per 100	gms. sat. sol.	Solid
NH_4NO_3	$\text{UO}_2(\text{NO}_3)_2$	Phase	NH_4NO_3	$\text{UO}_2(\text{NO}_3)_2$	Phase
65.72	0.0	NH ₄ NO ₃	24.92	49.33	2.1.2
60.84	6.9	"	22.13	52.00	"
51.84	18.10	"	20.99	54.35	" + UO ₂ (NO ₃) ₂ · 6H ₂ O
48.21	33.12	"	17.24	53.06	UO ₂ (NO ₃) ₂ · 6H ₂ O
43.26	30.54	"	10.38	51.79	"
35.19	40.23	" + 2.1.2	6.36	51.23	"
34.69	40.81	2.1.2	2.50	54.53	"
28.64	46.31	"	0.0	56.08	"

$$2.1.2 = 2\text{NH}_4\text{NO}_3 \cdot \text{UO}_2(\text{NO}_3)_2 \cdot 2\text{H}_2\text{O}$$

H₄

AMMONIUM

1112

AMMONIUM Uranyl NITRATES $\text{NH}_4\text{NO}_3 \cdot \text{UO}_2(\text{NO}_3)_2$ and $2\text{NH}_4\text{NO}_3 \cdot \text{UO}_2(\text{NO}_3)_2$.SOLUBILITY OF AMMONIUM URANYL NITRATES IN AQUEOUS NITRIC ACID AT 20°.
(Nichols, Hawes, et al, 1919.)Results for $\text{NH}_4\text{NO}_3 \cdot \text{UO}_2(\text{NO}_3)_2$.Results for $2\text{NH}_4\text{NO}_3 \cdot \text{UO}_2(\text{NO}_3)_2$.

Per cent HNO ₃ in solvent.	Gms. NH ₄ NO ₃ · UO ₂ (NO ₃) ₂ per 100 gms. solvent.	Solid Phase.	Per cent HNO ₃ in solvent.	Gms. 2NH ₄ NO ₃ · UO ₂ (NO ₃) ₂ per 100 gms. solvent.	Solid Phase.
0	165.0	UO ₂ (NO ₃) ₂ · 6H ₂ O	0	251.0	UO ₂ (NO ₃) ₂ · 6H ₂ O
10	128.5	"	10	201.0	"
20	80.3	"	20	150.0	"
30	68.2	"	30	144.0	"
40	60.5	"	40	380.0	NH ₄ NO ₃ · UO ₂ (NO ₃) ₂
20	144.5	NH ₄ NO ₃ · UO ₂ (NO ₃) ₂	10	380.0	"
30	144.0	"	20	215.0	"
40	95.6	"	30	150.0	"
50	61.4	"	40	98.2	"
60	38.6	"	50	58.0	"
			60	35.6	"

SOLUBILITY OF AMMONIUM NITRATE IN AQUEOUS ETHYL ALCOHOL.

(Fleckenstein — Physik. Z., 6, 419, '05.)

t°	Grams of NH ₄ NO ₃ Dissolved per 100 Grams Aq. Alcohol of (Wt. %):					
	100%.	86.77%.	76.12%.	51.65%.	25.81%.	0%.
20	2.5	11	23	70	140	195
30	4	14	32	90	165	230
40	5	18	43	115	196	277
50	6	24	55	144	244	365
60	7.5	30	70	183	320	...
70	9	41	93	230	...	...
80	10.5	56	...	...	...	...

NOTE. — The figures in the preceding table were read from curves shown in the abridged report of the work, and are, therefore, only approximately correct. Determinations of the solubility in methyl alcohol solutions were also made but not quoted in the abstract. The "Synthetic Method" was used.

100 grams absolute ethyl alcohol dissolve 4.6 grams NH_4NO_3 at 14° and 3.8 grams at 20.5°.

100 grams absolute methyl alcohol dissolve 14.6 grams NH_4NO_3 at 14°, 16.3 grams at 18.5° and 17.1 grams at 20.5°.

(Schiff and Monsacchi — Z. physik. Chem., 21, 277, '96; at 20.5° de Bruyn — *Ibid.*, 10, 783, '92.)

SOLUBILITY OF AMMONIUM NITRATE IN AQUEOUS ETHYL AND METHYL ALCOHOLS AND IN A MIXTURE OF THE TWO AT 30°.

(Schreinemakers, 1908 '09.)

Gms. per 100 Gms. Sat. Sol.			Gms. per 100 Gms. Sat. Sol.			Gms. per 100 Gms. Sat. Sol.		
H ₂ O.	C ₂ H ₅ OH.	NH ₄ NO ₃ .	H ₂ O.	CH ₃ OH.	NH ₄ NO ₃ .	H ₂ O.	$\frac{1}{2}\text{C}_2\text{H}_5\text{OH} + \frac{1}{2}\text{CH}_3\text{OH}$.	NH ₄ NO ₃ .
0	96.4	3.6	0	83.3	16.7	3.4	84.9	11.7
5	89.6	6.5	5	74.8	21.3	5	82.0	12.3
10	80.4	10.7	10	63.8	27.1	10	74.6	16.4
15	68.6	17	15	50.7	35	15	63.5	24
20	53.5	26.8	20	35.2	46.3	20	48.2	35.1
25	32.5	44.8	25	19.8	59	25	22.4	54
29.9	0	70.1	29.9	0	70.1	29.9	0	70.1

* Weight per cent C₂H₅OH = 51.7, C₂H₅OH = 48.3.

Additional determinations of the solubility of ammonium nitrate in aqueous ethyl alcohol solutions at 0°, 30° and 70° are given by deWaal (1910). At certain concentrations at 67.5° the solutions separate into two layers.

NO

EQUILIBRIUM IN THE SYSTEM AMMONIUM NITRATE, TERTIARY BUTYL
ALCOHOL AND WATER AT 25°.
(Ginnings, Herring and Webb, 1933.)

The composition of the homogeneous mixture, plait point, of the three components, as determined by the synthetic method, is 21.6 gms. NH_4NO_3 + 33.1 gms. tertiary Butyl alcohol, $(\text{CH}_3)_3\text{COH}$, per 100 gms. sat. solution. The original results for the remaining points on the binodal curve are not given, but only the values corresponding to derived empirical equations for the curve.

AMMONIUM NITRATE

The binodal curve for the system

Ammonium Nitrate + Allyl Alcohol + Water at 25° has been determined by Ginnings and Dees, 1935 but the authors do not give their experimental results but only the values of a series of constants calculated from them by means of an empirical equation. From these the conclusion is drawn that allyl alcohol seems to be more difficult to salt out than either iso propyl or normal propyl alcohol.

SOLUBILITY OF AMMONIUM NITRATE IN PURE ACETIC ACID, DETERMINED
BY THE FREEZING-POINT METHOD.

(Davidson and Geer, 1933.)

t°	Gm. Mols. NH_4NO_3 per 100 gm. mols. sat. sol.	t°	Gm. Mols. NH_4NO_3 per 100 gm. mols. sat. sol.	t°	Gm. Mols. NH_4NO_3 per 100 gm. mols. sat. sol.	t°	Gm. Mols. NH_4NO_3 per 100 gm. mols. sat. sol.
16.60	0.0 (1)	67.6	2.468	102.6	19.36	122.9	63.1
16.57	0.0741(1)	69.0	2.636	106.3	23.3	124.8	66.8
16.47	0.1287(1)	71.4	3.239	108.9	27.64	128.9	71.6
17.7	0.2832	72.8	3.447	110.6	31.25	131.4	75.0
21.4	0.3249	78.3	4.710	113.1	37.98	136.9	78.6
27.0	0.3916	80.9	5.508	115.6	43.31	143.1	82.3
33.6	0.5143	85.7	7.255	117.0	47.56	149.7	86.3
45.8	0.8745	89.0	8.620	118.3	51.67	157.8	89.6
61.2	1.634	97.1	13.68	120.0	55.5	167.5	100.0
63.5	1.887	101.0	17.15	121.4	60.1		

(1) The solid phase in these cases in CH_3COOH and NH_4NO_3 in all others. One liter sat. solution of Ammonium Nitrate in pure acetic acid contains 3.5 gms. NH_4NO_3 at 16.46°. (Eichelberger, 1934.)

EQUILIBRIUM IN THE SYSTEM AMMONIUM NITRATE, UREA AND WATER,
DETERMINED BY THE SYNTHETIC METHOD.
(Gorokhov, 1929.)

t°	Gms. per 100 gms. sat. sol.		Solid Phase	t°	Gms. per 100 gms. sat. sol.		Solid Phase
	CO(NH ₂) ₂	NH ₄ NO ₃			CO(NH ₂) ₂	NH ₄ NO ₃	
-20.6	30.0	21.0	Ice	-6.0	35.2	36.0	γCO(NH ₂) ₂
-18.1	25.0	22.5	"	-2.6	36.9	33.0	"
-16.8	20.0	24.0	"	+0.5	38.5	30.0	"
-14.9	15.0	25.5	"	2.6	40.0	27.3	"
-13.6	10.0	27.0	"	4.0	42.0	17.4	"
-11.0	0.0	30.0	"	8.3	44.0	16.8	"
-12.8	30.0	7.0	"	12.4	46.0	16.2	"
-9.5	20.0	8.0	"	16.8	48.0	15.6	"
-6.2	10.0	9.0	"	28.0	51.0	14.7	"
-3.7	0.0	10.0	"	30.8	55.0	13.5	"
-16.65	0.0	43.1	" + NH ₄ NO ₃	21.7	52.0	4.8	"
-11.1	32.9	0.0	" + αCO(NH ₂) ₂	27.6	55.0	4.5	"
-14.0	37.7	6.8	" "	7.2	37.2	47.0	"
-20.7	30.1	20.9	" "	8.9	37.8	46.0	"
-23.5	29.2	26.8	Ice + α + β	12.8	39.9	43.0	"
			CO(NH ₂) ₂	16.6	42.0	40.0	"
-25.5	28.4	31.7	Ice + β + γ	20.0	44.2	37.0	"
-26.5	29.8	35.1	" + γ	24.4	47.0	33.8	"
			α NH ₄ NO ₃	27.6	49.0	30.0	"
NO -18.5	7.7	41.0	" + β NH ₄ NO ₃	25.9	28.4	35.9	" + α NH ₄ NO ₃
-13.2	33.0	6.7	α CO(NH ₂) ₂	14.4	42.2	41.5	" + β NH ₄ NO ₃
-11.2	34.0	6.6	"	+ 6.6	36.8	47.4	"
-9.3	35.0	6.5	"	-18.5	30.5	49.5	γ CO(NH ₂) ₂ + α + β
-19.8	31.0	7.44	"				NH ₄ NO ₃
-7.4	36.4	2.07	α + β CO(NH ₂) ₂	+9.5	37.6	48.1	" + β + γ NH ₄ NO ₃
-19.6	31.3	20.6	"	-23.3	25.0	37.5	α NH ₄ NO ₃
-17.6	32.0	20.4	β CO(NH ₂) ₂	-19.2	20.0	40.0	"
-15.2	33.0	20.1	"	-15.3	15.0	42.5	"
-12.8	34.0	19.8	"	-11.8	10.0	40.0	"
-8.6	36.0	18.2	"	-8.7	5.0	47.5	"
-4.2	38.0	7.06	"	-5.8	0.0	50.0	"
-0.1	40.0	6.95	"	-12.2	31.9	42.0	β NH ₄ NO ₃
-6.2	37.0	6.3	"	-5.0	30.2	45.3	"
-0.2	40.0	6.0	"	+ 0.7	28.7	48.0	"
+ 3.5	42.0	5.8	"	7.0	27.0	51.0	"
8.7	45.0	5.5	"	7.9	36.5	48.0	"
12.2	47.0	5.3	"	12.0	25.7	53.5	β + γ NH ₄ NO ₃
15.7	49.0	5.4	"	10.0	35.6	49.2	"
16.2	49.2	5.0	β + γ CO(NH ₂) ₂	13.1	25.3	54.0	γ NH ₄ NO ₃
0.5	40.5	17.9	"	20.6	23.5	57.3	"
-21.2	30.0	35.0	γ CO(NH ₂) ₂	12.5	35.0	50.0	"
-7.6	35.0	32.5	"	14.9	34.3	51.0	"
+ 4.0	40.0	30.0	"	22.0	32.3	54.0	"
15.5	45.0	27.7	"	28.5	30.1	57.0	"
26.6	50.0	25.0	"				
-9.8	33.6	39.0	"				

Freezing-point data for mixtures of NH₄NO₃ + CO(NH₂)₂ and NH₄NO₃ + CO(NH₂)₂ + NaNO₃ are given by Howells, 1929, 1930.

AMMONIUM NITRATE

100 cc anhydrous Hydrazine dissolve 98 gms. NH_4NO_3 with decomposition at about 18°. (Welsh and Broderman, 1914.)

100 cc Pyridine dissolve 0.4 gms. NH_4NO_3 at 12° temp. (Muller, 1925.)

SOLUBILITY OF AMMONIUM NITRATE IN LIQUID AMMONIA.

t°	Gms. NH_4NO_3 per 100		t°	Gms. NH_4NO_3 per 100	
	cc NH_3	gms. NH_3		cc NH_3	gms. NH_3
-50.6	70.1	— (1)	-40.8	75.1	— (1)
-46.5	72.6	— (1)	-46.6	77.0	— (1)
-45.0	73.4	— (1)	-44.0	77.9	— (1)
-44.0	73.5	— (1)	*25	235.56	390.0 (2) ($d_{25} = 1.212$)

(1) Scherer, 1911; (2) Hunt, 1912.

SOLUBILITY OF AMMONIUM NITRATE IN LIQUID AMMONIA SOLUTIONS OF SODIUM CHLORIDE AND VICE VERSA AT 25°.

(Hunt and Bunge, 1928.)

One-fourth gram of the less soluble salt was mixed with variable amounts of the more soluble salt and ammonia added in excess. Ammonia was then allowed to escape until a single crystal of one salt separated from solution.

PO

Gm. Moles. per 10		Gm. Moles. per 10	
NaCl	NH_4NO_3	NaCl	NH_4NO_3
0.0	8.2875	0.667	5.85
0.484	8.50	0.534	1.562
0.655	8.60	0.088	0.0
0.632	7.12		

Freezing-point data are given for:

NH_4NO_3 + AgNO_3	(Flavitskii, 1909; Zawadzki, 1904.)
" + $(\text{NH}_4)_2\text{SO}_4$	(Bowen, 1926.)
" + NaCl	(Perman, 1922.)
" + " + NaNO_3	" "
" + NaNO_2	(Perman, 1922; Farley and Lowry, 1922.)
" + Na_2SO_4	(Perman and Harrison, 1924.)
" + $\text{Pb}(\text{NO}_3)_2$	(Bogitch, 1915.)

AMMONIUM Hydrogen PHOSPHITE $(\text{NH}_4\text{H})\text{HPO}_3$.

100 grams water dissolve 171 grams $(\text{NH}_4\text{H})\text{HPO}_3$ at 0°, 190 grams at 14.5° and 260 grams at 31°. (Amat, 1887.)

AMMONIUM Hypo. PHOSPHITE $\text{NH}_4\text{H}_2\text{PO}_3$.

100 cc. H_2O dissolve 83 gms. $\text{NH}_4\text{H}_2\text{PO}_3$ at room temp. (Squire and Caines, 1905.)

AMMONIUM PHOSPHATES Mono, NH₄H₂PO₄ and Di, (NH₄)₂HPO₄.

SOLUBILITY OF EACH IN WATER.

(Buchanan and Winner, 1920.)

Results for Monoammonium Phosphate. Results for Diammonium Phosphate.

t.	Gms. NH ₄ H ₂ PO ₄ per 100 gms.	
	Sat. sol.	H ₂ O.
0.....	18.5	22.7
10.....	22.8	29.5
20.....	27.2	37.4
30.....	31.7	46.4
40.....	36.2	56.7
60.....	45.2	82.5
80.....	54.2	118.3
100.....	63.4	173.2
110.5.....	68.3	215.0

t.	Gms. (NH ₄) ₂ HPO ₄ per 100 gms.	
	Sat. sol.	H ₂ O.
0.....	30.0	42.9
10.....	38.6	62.8
20.....	40.8	69.0
30.....	42.9	75.2
40.....	45.0	81.8
50.....	47.2	89.2
60.....	49.3	97.3
70.....	51.4	106.0

Additional determinations for monoammonium phosphate, agreeing fairly closely with the above, are given by Apfel, 1911.

PO

The above values for mono ammonium phosphate were confirmed by Jänecke, 1927. Subsequent determinations by Ross, Merz and Jacob, 1929 are somewhat lower than the above results at the lower temperatures and slightly higher at the upper temperatures. These investigators also give a value for the solubility of diammonium phosphate in water at 25° which is lower than the interpolated value from the above table. They give as the solubility of tri ammonium phosphate in water at 25°, the value, 17.7 gms. per 100 gms. H₂O. Wolkowitsch, Berlin and Manzew, 1932, found 19.0 gms. (NH₄)₃PO₄ per 100 gms. H₂O at 25°.

The following additional determinations of the Solubility of Diammonium Phosphate in Water, determined by the synthetic method, at temperatures above 100°, are given by Jänecke, 1936.

t°	Gms. (NH ₄) ₂ HPO ₄ per 100 gms. sat. sol.	t°	Gms. (NH ₄) ₂ HPO ₄ per 100 gms. sat. sol.
117	63.0	180	80.6
122	65.9	191	83.1
160	74.8	250 m.pt.	100.0

The temperature is that of complete solution of the solid phase.

EQUILIBRIUM IN THE SYSTEM AMMONIA, PHOSPHORUS
PENTOXIDE AND WATER AT 0° AND AT 25°.
(Jänecke, 1927.)

Results at 0°

Percent NH₃
in dissolved
NH₃ + P₂O₅

Gms. H₂O to
dissolve 100
gms. NH₃ + P₂O₅

Percent NH₃
in dissolved
NH₃ + P₂O₅

Gms. H₂O to
dissolve 100
gms. NH₃ + P₂O₅

Percent NH₃
in dissolved
NH₃ + P₂O₅

Gms. H₂O to
dissolve 100
gms. NH₃ + P₂O₅

92.2	1090	34.0	659	95.3	563
86.1	1480	31.0	257	85.8	881
75.0	1870	26.0	210	60.7	1090
68.0	2075	24.5	315	41.5	705
65.0	2110	24.0	326	32.5	222
55.7	1990	19.2	486	27.2	127
42.0	1440	6.0	65.8	22.5	92.2
				20.1	333
				12.62	232
				8.60	63.7

Using the above results supplemented by those of Parravano and Mieli, 1908, upon this system, the author obtained the following results for solutions saturated with NH₄H₂(PO₄)₂ + H₃PO₄.

t°	Percent NH ₃ in dissolved NH ₃ + P ₂ O ₅	Gms. H ₂ O to dissolve 100 gms. NH ₃ + P ₂ O ₅	t°	Percent NH ₃ in dissolved NH ₃ + P ₂ O ₅	Gms. H ₂ O to dissolve 100 gms. NH ₃ + P ₂ O ₅
0	0	73.0	25	4.2	32.7
"	3.2	79.0	"	4.9	58.1
"	5.9	126.6	"	7.1	97.5
"	10.0	185.0	"	10.8	140.0

The author also gives data for the quaternary system NH₃ + K₂O + P₂O₅ + H₂O at 0° and at 25°.

SOLUBILITY OF AMMONIUM PHOSPHATES IN AQUEOUS SOLUTIONS OF ORTHO
PHOSPHORIC ACID AT 25°.
(Parker, 1914.)

Gms. per 100 Gms. Sat. Solution.		Solid Phase.	Gms. per 100 Gms. Sat. Solution.		Solid Phase.
H ₃ PO ₄ .	NH ₃ .		H ₃ PO ₄ .	NH ₃ .	
4.1	22.6	(NH ₄) ₃ PO ₄ ·3H ₂ O	40	9	NH ₄ H ₂ PO ₄
4.4	18.4	"	30	5.4	"
10	13.1	"	20.6	4	"
20	7	"	30	3.8	"
30	7.7	"	40	4	"
34.4	10	(NH ₄) ₃ PO ₄ ·3H ₂ O + (NH ₄) ₂ HPO ₄	50	4.2	"
40	10.2	(NH ₄) ₂ HPO ₄	60.6	4.4	"
48.2	11.6	(NH ₄) ₂ HPO ₄ + NH ₄ H ₂ PO ₄			

The original figures have been calculated to grams, plotted on cross-section paper and the above table read from the curve.

Data for this system are also given by D'Ans and Schreiner (1910). The agreement is satisfactory except for the (NH₄)₃PO₄·3H₂O end of the curve, for which much lower values for the NH₃ component are given by D'Ans and Schreiner.

AMMONIUM PHOSPHATES

EQUILIBRIUM IN THE SYSTEM AMMONIA, ORTHO PHOSPHORIC ACID
AND WATER, DETERMINED BY THE SYNTHETIC METHOD.

(Jänecke, 1936.)

The temperatures are those at which the last trace of solid phase disappeared.

t°	Wt. Percent		Solid Phase	t°	Wt. Percent		Solid Phase
	NH ₃	H ₂ O			NH ₃	H ₂ O	
90(?)	6.5	35.0	NH ₄ H ₆ (PO ₄) ₂	185(?)	22.6	19.2	(NH ₄) ₃ PO ₄ · 2H ₂ O
49	5.9	3.0	"	187	21.5	22.3	"
—	11.3	2.2	NH ₄ H ₂ PO ₄	146	18.5	32.6	"
126	8.5	30.0	"	148	18.7	36.3	"
88	6.5	30.0	"	149	19.1	41.1	"
93	11.0	35.0	"	124	16.7	40.9	"
85	8.5	35.0	"	115	19.3	58.9	"
88	10.0	40.0	"	138	18.6	57.0	"
—	17.0	30.7	(NH ₄) ₂ H ₂ PO ₄	121	27.0	17.0	"
164	18.5	22.6	"	117	16.6	57.3	"
180	16.4	18.4	"	125(?)	16.5	51.4	"
110	15.0	30.0	"	114	15.3	52.5	"
100	12.5	30.0	"	95	13.9	53.9	"
72	13.5	35.0	"	101	17.8	69.6	"
58	13.2	41.8	"				
53	12.5	40.0	"				

PO

The author also gives similar determinations for the region of the system in which two liquid layers are formed.

SOLUBILITY OF MONOAMMONIUM PHOSPHATE IN AQUEOUS SOLUTIONS OF AMMONIUM
SULFATE AT 25°. (Apfel, 1911.)

Mols. per 1000 gms. sat. sol.		Gms. per 100 gms. sat. sol.		Mols. per 100 gms. sat. sol.		Gms. per 100 gms. sat. sol.	
PO ₄	SO ₄	NH ₄ H ₂ PO ₄	(NH ₄) ₂ SO ₄	PO ₄	SO ₄	NH ₄ H ₂ PO ₄	(NH ₄) ₂ SO ₄
2.58	0.0	29.7	0.0	1.53	1.43	17.6	18.90
2.40	0.17	27.6	2.25	1.31	1.84	15.1	24.31
2.34	0.27	26.9	3.57	0.99	2.55	11.4	33.68
2.26	0.35	26.0	4.62	0.82	2.92	9.44	38.58
1.78	1.05	20.5	13.87	0.814	2.89	9.37	38.18

EQUILIBRIUM IN THE SYSTEM DIAMMONIUM PHOSPHATE, ISO PROPYL
ALCOHOL AND WATER AT 25°.
(Ginnings and Chen, 1931.)

The points on the binodal curve of this system were determined by observing the appearance or disappearance of clouding in a mixture of weighed amounts of the salt and one of the liquids upon addition of weighed amounts of the other. Tie lines, *, were located by means of determinations of the salt in pairs of liquid layers in contact with each other, and the Plait Point, PP, was found by plotting.

Gms. per 100 gms. homogeneous mixture		Gms. per 100 gms. homogeneous mixture	
$(\text{NH}_4)_2\text{HPO}_4$	iso $\text{C}_3\text{H}_7\text{OH}$	$(\text{NH}_4)_2\text{HPO}_4$	iso $\text{C}_3\text{H}_7\text{OH}$
3.48	39.20*	17.19	14.11
5.55	32.84	18.10	13.19
9.53	24.80	23.20	8.79
11.8	21.6 PP	27.14	6.18
12.74	20.10	32.84	3.62*
16.48	14.90		

The composition of the homogeneous mixture (plait point) of the system composed of Di Ammonium Phosphate, Tertiary Butyl Alcohol and Water at 25° was found by Ginnings, Herring and Webb, 1933, to be 3.8 percent $(\text{NH}_4)_2\text{HPO}_4$ + 33.8 percent tertiary $(\text{CH}_3)_3\text{COH}$ + 62.4 percent H_2O . The original results for the remaining points on the binodal curve are not given but only the values of constants calculated by means of empirical equations.

The binodal curve for the system Di Ammonium Phosphate, Allyl Alcohol and Water at 25° was determined by Ginnings and Dees, 1935, but the authors give only the values of constants calculated by means of empirical equations. The conclusion is drawn that allyl alcohol seems to be more difficult to salt out than either normal or iso propyl alcohol.

AMMONIUM Sodium PHOSPHATES

Data for the distribution of each of 5 ammonium sodium ortho- and pyrophosphates between water and chloroform at 18°, are given by Abbott and Bray (1909).

AMMONIUM Zinc PHOSPHATE NH_4ZnPO_4

100 cc sat. solution of Ammonium Zinc Phosphate in Water contain 0.0136 gm. NH_4ZnPO_4 at 10.5° and 0.0145 gm. at 17.5°. (Artmann, 1915.)

AMMONIUM PerRHENATES

One liter sat. solution of Ammonium Per Rhenate in water contain about 120 gms. NH₄ReO₄ at 20°, (Noddak and Noddak, 1929.)

100 gms. sat. solution of Ammonium Sulfo Per Rhenate in Water contain 58.5 gms. NH₄ReO₃S at 20°. (Feit, 1931.)

AMMONIUM SULFIDE (NH₄)₂S.

100 gms. Liquid Ammonia dissolve 120 gms. (NH₄)₂S at 25°. (Hunt and Boncyk, 1933.)

AMMONIUM Antimony SULFIDE (Sulfoantimonate) (NH₄)₃SbS_{4.4}H₂O.
SOLUBILITY IN WATER AND IN AQUEOUS ALCOHOL.

(Donk, 1908)

t°.	In Water. Gms. (NH ₄) ₃ SbS ₄ per 100 Gms. Sat. Sol.	Solid Phase.	In Aqueous Alcohol at 10°.	
			Gms. per 100 Gms. C ₂ H ₅ OH.	Gms. Sat. Solution. (NH ₄) ₃ SbS ₄ .
- 1.9	9.9	Ice	0	43.2
- 5	20	"	5.1	35.9
- 8	30.2	"	19.1	23.1
- 13.5	41.6	Ice + (NH ₄) ₃ SbS _{4.4} H ₂ O	43.1	8.7
0	41.6	(NH ₄) ₃ SbS _{4.4} H ₂ O	53.1	4.1
+ 20	47.7	"	93.3	0
30	54.5	"		

AMMONIUM SULFITE (NH₄)₂SO₃·H₂O.

SOLUBILITY OF AMMONIUM SULFITE IN WATER.

(Ishikawa and Marooka, 1928, 1933.)

t°	d. of sat. sol.	Gms. (NH ₄) ₂ SO ₃ per 100 gms. sat. sol.	Solid Phase	t°	d. of sat. sol.	Gms. (NH ₄) ₂ SO ₃ per 100 gms. sat. sol.	Solid Phase
- 1.73	—	4.961	Ice	25	1.2042	19.29	(NH ₄) ₂ SO ₃ ·H ₂ O
- 3.35	—	9.698	"	30	1.2097	40.77	"
- 6.27	—	16.817	"	40	1.2203	44.96	"
- 9.69	—	23.652	"	50	1.2306	47.26	"
- 12.96	—	28.855	" + (NH ₄) ₂ SO ₃ ·H ₂ O	60	1.2424	50.94	"
				70	1.2558	54.71	"
- 11.52	—	29.16	(NH ₄) ₂ SO ₃ ·H ₂ O	80	1.2716	58.99	"
- 6.55	—	30.62	" + (NH ₄) ₂ SO ₃ ·H ₂ O	80.8	rr. pt.	—	" + (NH ₄) ₂ SO ₃
0	1.1792	32.40	"	85	—	59.53	(NH ₄) ₂ SO ₃
+ 10	1.1896	35.05	"	90	—	60.00	"
15	1.1943	36.40	"	100	—	60.44	"
20	1.1995	37.80	"				

SOLUBILITY OF AMMONIUM SULFITE IN AQUEOUS SOLUTIONS OF
AMMONIUM SULFATE AND VICE VERSA.

(Ishikawa and Murooka, 1929.)

Results at 15°

Results at 30°

Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase
$(\text{NH}_4)_2\text{SO}_3$	$(\text{NH}_4)_2\text{SO}_4$		$(\text{NH}_4)_2\text{SO}_3$	$(\text{NH}_4)_2\text{SO}_4$	
36.40	0.0	$(\text{NH}_4)_2\text{SO}_3 \cdot \text{H}_2\text{O}$	40.77	0.00	$(\text{NH}_4)_2\text{SO}_3 \cdot \text{H}_2\text{O}$
34.10	3.64	"	38.86	2.83	"
31.22	7.98	"	36.19	6.99	"
29.73	10.31	"	33.33	11.19	"
27.11	14.19	"	31.03	14.30	"
25.65	16.94	"	28.04	19.61	"
22.81	21.76	"	25.87	23.31	"
21.92	23.38	"	24.64	25.21	" + $(\text{NH}_4)_2\text{SO}_4$
19.72	27.20	" + $(\text{NH}_4)_2\text{SO}_4$	18.41	29.60	$(\text{NH}_4)_2\text{SO}_4$
17.15	28.80	$(\text{NH}_4)_2\text{SO}_4$	12.66	33.88	"
13.63	31.68	"	8.41	37.13	"
9.69	34.82	"	2.74	41.68	"
5.45	38.08	"	0.0	43.87	"
0.0	42.52	"			

SIMULTANEOUS SOLUBILITY OF AMMONIUM SULFITE AND AMMONIUM
SULFATE IN WATER.

(Ishikawa and Murooka, 1929.)

t°	Gms. per 100 gms. sat. sol.		t°	Gms. per 100 gms. sat. sol.	
	$(\text{NH}_4)_2\text{SO}_3$	$(\text{NH}_4)_2\text{SO}_4$		$(\text{NH}_4)_2\text{SO}_3$	$(\text{NH}_4)_2\text{SO}_4$
-21.5	10.89	30.57	50	32.75	21.89
-11.52	12.88	29.85	70	42.28	17.71
0	15.41	29.05	80	48.26	15.13
15	19.72	27.20	90	49.14	15.01
30	24.64	25.21	100	50.53	14.80

Solid Phase $(\text{NH}_4)_2\text{SO}_3 \cdot \text{H}_2\text{O}$ + $(\text{NH}_4)_2\text{SO}_4$ up to 80° and $(\text{NH}_4)_2\text{SO}_3$ + $(\text{NH}_4)_2\text{SO}_4$ thereafter.

AMMONIUM Pyro SULFITE $(\text{NH}_4)_2\text{S}_2\text{O}_5$.

100 gms. sat. solution of Ammonium Pyro sulfite in Water contain 71.33 gms. $(\text{NH}_4)_2\text{S}_2\text{O}_5$ at 25°. (Ishikawa and Hagiwara, 1931.) The authors also give results for the systems $(\text{NH}_4)_2\text{S}_2\text{O}_5$ + $(\text{NH}_4)_2\text{SO}_3$ + H_2O and $(\text{NH}_4)_2\text{S}_2\text{O}_5$ + SO_2 + H_2O at 25°.

100 gms. liquid Sulfur Dioxide dissolve 0.048 gm. $(\text{NH}_4)_2\text{S}_2\text{O}_4$ at 0°: (Jander and Ruppolt, 1937.)

AMMONIUM Sodium Hydrogen SULFITE $(\text{NH}_4)\text{Na}_2\text{H}(\text{SO}_3)_2 \cdot \text{H}_2\text{O}$.

100 gms. H_2O dissolve 42.3 gms. salt at 12.4° and 48.5° gms. at 15°.

(Schwincker, 1889.)

AMMONIUM SULFATE (NH₄)₂SO₄.

SOLUBILITY IN WATER.

(Average curve from the results of Rodebush, 1918; Sborgi and Bovalini, 1924; Sborgi, Bovalini and Medici, 1924; Sborgi, 1924; Nishizawa, 1920; Britton, 1922; Claven and Mitchell, 1924; and Weston, 1922.)

t°.	Gms. (NH ₄) ₂ SO ₄ per 100 gms. sat. sol.	Solid Phase.	t°.	Gms. (NH ₄) ₂ SO ₄ per 100 gms. sat. sol.	Solid Phase.	t°.	Gms. (NH ₄) ₂ SO ₄ per 100 gms. sat. sol.	Solid Phase.
— 5.....	17.0	Ice	0 ..	41.35	(NH ₄) ₂ SO ₄	25...	43.3	(NH ₄) ₂ SO ₄
— 10.....	28.0	»	+ 5 ..	41.65	»	30...	43.75	»
— 15.....	36.0	»	10...	42.05	»	40 ..	44.7	»
— 19 (Eutec.)	39.8	» + (NH ₄) ₂ SO ₄	15...	43.45	»	50 ..	45.8	»
— 10.....	40.5	(NH ₄) ₂ SO ₄	20...	42.85	»	60...	47.0	»

The density of the sat. solution at 15° is 1.248, and at 10° it is 1.241.

Later determinations by Ishikawa and Murooka, 1939 are as follows:

t°	Gms. (NH ₄) ₂ SO ₄ per 100 gms. sat. sol.	Solid Phase	t°	Gms. (NH ₄) ₂ SO ₄ per 100 gms. sat. sol.	Solid Phase
- 1.05	3.246	Ice	35	43.47	(NH ₄) ₂ SO ₄
- 3.70	12.233	"	40	43.87	"
- 5.28	17.102	"	40	44.80	"
- 18.5 Eutec	39.75	" + (NH ₄) ₂ SO ₄	50	45.75	"
- 11.52	40.42	(NH ₄) ₂ SO ₄	60	46.64	"
- 6.55	40.59	"	70	47.54	"
0	41.22	"	80	48.47	"
10	42.11	"	90	49.44	"
15	42.52	"	100	50.42	"
20	43.00	"	108.5 b.pt.	51.53	"

Individual determinations by a number of other investigators are usually in good agreement with the above results.

The following results for the Solubility of Ammonium Sulfate at temperatures above 100°, determined by the synthetic method, are given by Benrath, Gjedebø, Schiffrs and Wunderlich, 1937.

t°	Gms. (NH ₄) ₂ SO ₄ per 100 gms. sat. sol.	t°	Gms. (NH ₄) ₂ SO ₄ per 100 gms. sat. sol.	t°	Gms. (NH ₄) ₂ SO ₄ per 100 gms. sat. sol.
100	50.8	225	62.0	325	71.5
125	53.2	250	64.2	350	74.0
150	55.5	275	66.7	375	76.5
175	57.5	300	69.2	400	78.7
200	59.7				

SOLUBILITY OF AMMONIUM SULFATE IN AQUEOUS SOLUTIONS OF SULFURIC
ACID AT 30°.
(Van Dorp, 1910 and 1911.)

Gms. per 100 Gms. Sat. Solution.		Solid Phase.	Gms. per 100 Gms. Sat. Solution.		Solid Phase.
$(\text{NH}_4)_2\text{SO}_4$.	H_2SO_4 .		$(\text{NH}_4)_2\text{SO}_4$.	H_2SO_4 .	
44.3	0	$(\text{NH}_4)_2\text{SO}_4$	32.8	40	$(\text{NH}_4)\text{HSO}_4$
43.6	10	"	26.1	45	"
44.1	13.2	$(\text{NH}_4)_2\text{SO}_4 + 3.1$	20.9	50	"
42.9	15	3.1	17.6	55	"
41	20	"	17.8	60	"
40.8	25	"	20	61.7	"
43	30	"	30	62.9	"
45.5	33.8	$3.1 + (\text{NH}_4)\text{HSO}_4$	37	62.2	"
42.3	35	$(\text{NH}_4)\text{HSO}_4$			
$3.1 = 3[(\text{NH}_4)_2\text{SO}_4] \cdot \text{H}_2\text{SO}_4$					

Additional results for this system are given by D'Ans, 1909, 1913.
Results for the solubility of mixtures of ammonium sulfate and lithium
sulfate in concentrated H_2SO_4 containing traces of H_2O at 30°, are given
by Van Dorp, 1913-14.

SO

EQUILIBRIUM IN THE SYSTEM AMMONIUM SULFATE, SULFURIC
ACID AND WATER.

(Locutzy and Laffitte, 1933, 1934.)

Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase
H_2SO_4	$(\text{NH}_4)_2\text{SO}_4$		H_2SO_4	$(\text{NH}_4)_2\text{SO}_4$	

Results at 30°			Results at 50° (con.)		
0.0	44.03	$(\text{NH}_4)_2\text{SO}_4$	34.35	50.96	$(3.1) + \text{NH}_4\text{HSO}_4$
13.11	44.71	" + MC(4.1) + (3.1)	54.28	25.5	NH_4HSO_4
25.31	41.48	MC(4.1) + (3.1)	60.5	39.5	"
33.88	45.44	" + NH_4HSO_4			
59.27	17.62	NH_4HSO_4	Results at 70°		
61.5	38.5	"	0.0	58.08	$(\text{NH}_4)_2\text{SO}_4$

Results at 50°					
0.0	45.79	$(\text{NH}_4)_2\text{SO}_4$	17.5	50.5	" + MC(4.1) + (3.1)
15.25	47.82	" + (4.1)	24.62	49.02	(3.1)
17.92	46.29	(4.1)	34.92	54.97	" + NH_4HSO_4
24.60	45.51	MC(4.1) + (3.1)	55.02	31.15	NH_4HSO_4
			59.45	40.55	"

$(4.1) = 4(\text{NH}_4)_2\text{SO}_4 + \text{H}_2\text{SO}_4$; $(3.1) = 3(\text{NH}_4)_2\text{SO}_4 \cdot \text{H}_2\text{SO}_4$.

Determinations at 0° and 90° were also made but the numerical results
are not given in the present papers.

NH₄

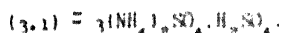
AMMONIUM

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EQUILIBRIUM IN THE SYSTEM AMMONIUM SULFATE, SULFURIC ACID AND WATER AT 25° C.

(Lain and Kohlstedt, 1930.)

Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase
H ₂ SO ₄	(NH ₄) ₂ SO ₄		H ₂ SO ₄	(NH ₄) ₂ SO ₄	
0.0	49.45	(NH ₄) ₂ SO ₄	15.9	48.41	14.11 + NH ₄ HSO ₄
8.75	48.87	"	19.49	47.45	NH ₄ HSO ₄
14.73	49.95	"	24.4	46.94	"
20.45	49.27	" + 14.11	27.18	46.78	"
23.0	53.28	(14.1)	32.8	46.26	"
27.66	54.01	"	34.0	46.1	"
29.81	54.7	"	34.75	46.71	"
32.43	56.23	"	35.15	46.15	"
34.21	57.68	"	35	45	"
35.5	57.5	"			



SOLUBILITY OF AMMONIUM SULFATE IN AQUEOUS SOLUTIONS OF AMMONIA AT 25°.

(Dana and Seifert, 1910.)

SO	Gms. per 1000 gms. sat. sol.		Gms. per 1000 gms. sat. sol.	
	(NH ₃) ₂	(NH ₄) ₂ SO ₄	NH ₃	(NH ₄) ₂ SO ₄
0	3.28		0.0	413.4
1.02	2.60		14.8	343.6
1.95	2.13		26.4	281.5
3.44	1.59		117.2	210.1
5.35	1.16		182.2	151.3
7.13	0.78		242.8	103
9.47	0.0		322.4	0

SOLUBILITY OF AMMONIUM SULFATE IN AQUEOUS SOLUTIONS OF SODIUM SULFATE AND VICE VERSA.

(Results of 15° and at 25° by Froelich and Kohlstedt, 1922, at 25° and 30° by Freeth, 1924.)

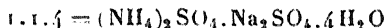
Results at 15°.				Results at 35°.			
d of sat. sol.	Gms. per 100 gms. H ₂ O		Solid Phase	d of sat. sol.	Gms. per 100 gms. H ₂ O		Solid Phase
	Na ₂ SO ₄	(NH ₄) ₂ SO ₄			Na ₂ SO ₄	(NH ₄) ₂ SO ₄	
1.245	0.0	73.49	NH ₄ HSO ₄	1.240	0.0	84.74	(NH ₄) ₂ SO ₄
1.253	2.86	71.14	"	1.259	6.48	78.30	"
1.259	4.91	72.86	"	1.266	11.80	72.00	"
1.261	7.26	72.15	"	1.267	18.67	71.40	"
1.272	7.79	71.06	"	1.268	20.13	71.20	"
1.286	12.77	69.70	"	1.275	23.64	66.11	113
1.280	14.05	65.01	"	1.282	27.15	58.59	"
1.276	16.36	54.60	"	1.284	28.81	54.94	"
1.276	18.57	48.98	"	1.284	30.76	51.44	"
1.276	21.23	43.20	"	1.288	30.18	45.12	"
1.278	22.87	36.92	"	1.288	30.18	41.15	"
1.279	24.47	34.08	"	1.288	30.13	36.70	0.5Na ₂
1.280	25.44	33.80	"	1.282	31.45	26.64	Na ₂ SO ₄
1.286	26.29	34.79	0.5Na ₂ SO ₄ + H ₂ O	1.280	30.15	19.61	"
1.265	28.91	30.93	Na ₂ SO ₄ + H ₂ O	1.284	30.01	14.27	"
1.187	18.02	11.98	"	1.287	32.40	6.91	"
1.111	13.96	0.00	"	1.285	39.24	0.00	"

Results at 25°.

Gms. per 100 gms. sat. sol.		Solid Phase
Na ₂ SO ₄ .	(NH ₄) ₂ SO ₄ .	
3.35	41.23	(NH ₄) ₂ SO ₄
6.65	39.16	"
8.00	38.70	" + 1.1.4 ^a
14.12	27.42	1.1.4
23.90	15.8	"
25.76	14.1	" + Na ₂ SO ₄ ·10H ₂ O
24.5	12.5	Na ₂ SO ₄ ·10H ₂ O
21.78	7.4	"

Results at 60°.

Gms. per 100 gms. sat. sol.		Solid Phase.
Na ₂ SO ₄ .	(NH ₄) ₂ SO ₄ .	
0.0	46.80	(NH ₄) ₂ SO ₄
10.70	40.30	"
16.33	36.91	" + Na ₂ SO ₄
18.70	29.48	Na ₂ SO ₄
26.94	9.70	"
31.20	0.00	"

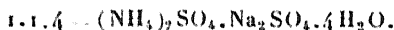


Freeth also gives complete data for the quaternary equilibrium in the system : $(\text{NH}_4)_2\text{SO}_4 + \text{NH}_4\text{ClO}_4 + \text{Na}_2\text{SO}_4 + \text{NaClO}_4 + \text{H}_2\text{O}$ at 25° and at 60°.

100 gms. H₂O dissolve 46.6 gms. NH₄NaSO₄·2H₂O at 15° and the density of the sat. solution is 1.1749.

EQUILIBRIUM IN THE SYSTEM AMMONIUM SULFATE + SODIUM
SULFATE + WATER.

(This system has been studied in great detail by Dawson, 1918; Matignon and Meyer, 1917-1918 and Levi, 1924. Results at selected temperatures are given by Nishizawa, 1920; Fedotieff and Kolossoff, 1923; Sborgi et. al., 1924; and Freeth, 1924. Levi presents a diagram constructed from all available determinations and his results agree in general with the curves obtained. The following table is taken from the paper of Dawson.)



t°.	Gms. per 100 gms. H ₂ O.		Mols. per 1000 mols. H ₂ O.		Solid Phase.
	Na ₂ SO ₄ .	(NH ₄) ₂ SO ₄ .	Na ₂ SO ₄ .	(NH ₄) ₂ SO ₄ .	
-19.5 (Eutec.).	5.29	63.5	6.70	86.6	Ice + Na ₂ SO ₄ ·10H ₂ O + (NH ₄) ₂ SO ₄
-18.....	5.40	63.5	6.85	86.6	Na ₂ SO ₄ ·10H ₂ O + (NH ₄) ₂ SO ₄
-16.....	5.32	63.6	6.75	86.8	" " + 1.1.4
-13.....	5.68	64.9	7.20	88.5	(NH ₄) ₂ SO ₄ + 1.1.4
-10.....	6.33	65.6	8.03	89.2	" "
0.....	7.81	66.7	9.9	91.0	" "
+15.....	10.85	69.6	13.75	94.9	" "
25.....	14.6	71.0	18.5	96.8	" "
40.....	19.7	75.1	25.0	102.4	" "
50.....	25.8	76.1	32.7	103.8	" "
-13.....	6.52	58.6	8.26	79.9	Na ₂ SO ₄ ·10H ₂ O + 1.1.4
-10.....	7.78	56.1	9.86	76.5	" "
0.....	12.05	46.6	15.25	63.5	" "
+15.....	22.9	33.3	29.0	45.4	" "
20.....	31.5	28.9	39.9	39.4	" "
25.....	40.9	22.1	51.8	30.2	" "
26.5.....	45.2	21.0	57.3	28.6	" " + Na ₂ SO ₄
35.0.....	41.7	28.7	52.9	39.2	Na ₂ SO ₄ + 1.1.4
40.....	40.5	34.7	51.3	47.3	" "
50.....	37.2	50.5	47.2	68.9	" "
55.....	36.0	62.0	45.6	81.6	" "
25.....	32.9	30.5	41.6	41.6	1.1.4
35.....	37.3	34.7	47.3	47.3	"
54.3.....	34.3	77.7	43.5	106.0	1.1.4 + Na ₂ SO ₄ + (NH ₄) ₂ SO ₄
75.....	36.1	84.3	45.7	115.0	Na ₂ SO ₄ + (NH ₄) ₂ SO ₄
100.....	37.9	95.0	48.0	129.5	" "

H_4 AMMONIUM

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EQUILIBRIUM IN THE SYSTEM AMMONIUM SULFATE NICKEL SULFATE AND WATER AT 25° . (Hill and Taylor, 1930.)

Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase
$NiSO_4$	$(NH_4)_2SO_4$		$NiSO_4$	$(NH_4)_2SO_4$	
0.0	43.42	$(NH_4)_2SO_4$	1.80	1.27	1.1.6
0.023	43.36	" + 1.1.6	12.12	1.94	"
0.048	35.20	1.1.6	18.24	1.49	"
0.079	39.44	"	22.75	1.24	"
0.125	23.91	"	26.20	1.01	"
0.209	17.87	"	28.93	0.81	" + $NiSO_4 \cdot 7H_2O$
0.352	12.57	"	28.95	0.0	$NiSO_4 \cdot 7H_2O$

$$1.1.6 = (NH_4)_2SO_4 \cdot NiSO_4 \cdot 6H_2O.$$

The previous determinations upon this system at 25° by Caven and Gardner, 1933, are considered by Hill and Taylor to be incorrect.

AMMONIUM Nickel SULFATE $(NH_4)_2NiSO_4 \cdot 6H_2O$.

SOLUBILITY IN WATER.

(Average curve from Lohler, Leake, at 25°)

t°	G. $(NH_4)_2NiSO_4$ per 100 gms.		t°	G. $(NH_4)_2NiSO_4$ per 100 gms.	
	Water	Solution		Water	Solution
0	1.0	0.00	40	12.0	10.72
10	4.0	3.85	50	14.5	12.96
20	6.5	6.10	60	17.0	14.53
25	7.57	7.04	70	20.0	16.66
30	9.0	8.45			

EQUILIBRIUM IN THE SYSTEM AMMONIUM SULFATE, NICKEL SULFATE AND WATER AT SEVERAL TEMPERATURES. (Hearath, 1935.)

t°	Gms. per 100 gms. sat. solution		Solid Phase	t°	Gms. per 100 gms. sat. solution		Solid Phase
	$NiSO_4$	$(NH_4)_2SO_4$			$NiSO_4$	$(NH_4)_2SO_4$	
0	trace	41.2	1.1.6 + $(NH_4)_2SO_4$	0.33	45.12	1.1.6 + $(NH_4)_2SO_4$	
"	24.45	1.23	" + $NiSO_4 \cdot 7H_2O$	"	12.95	1.94	" + $NiSO_4 \cdot 6H_2O$
35	0.1	43.7	" + $(NH_4)_2SO_4$	24	15.15	2.03	" + $(NH_4)_2SO_4$
"	29.5	1.20	" + $NiSO_4 \cdot 7H_2O$	40	0.24	48.68	" + $(NH_4)_2SO_4$
29	32.03	1.29	" + $NiSO_4 \cdot 6H_2O$	"	41.84	1.02	" + $NiSO_4 \cdot 6H_2O$
				"	1.10	49.9	" + $(NH_4)_2SO_4$
				"	46.91	1.11	" + $NiSO_4 \cdot 6H_2O$

EQUILIBRIUM IN THE SYSTEM AMMONIUM NICKEL SULFATE, AMMONIUM ZINC SULFATE AND WATER AT 25° . (Hill and Taylor, Jr., 1930.)

Gms. per 100 gms. sat. solution		Solid Phase	Gms. per 100 gms. sat. solution		Solid Phase
$(NH_4)_2SO_4 \cdot ZnSO_4$	$(NH_4)_2SO_4 \cdot NiSO_4$		$(NH_4)_2SO_4 \cdot ZnSO_4$	$(NH_4)_2SO_4 \cdot NiSO_4$	
12.24	0.0		71.09	0.0	
9.29	1.54		45.80	27.19	
8.27	2.16		17.08	35.86	
6.93	2.75		28.75	44.06	
5.11	1.94		11.87	48.93	
1.97	5.70		5.73	66.89	
0.0	7.09		0.0	72.62	

AMMONIUM Lead SULFATE $(\text{NH}_4)_2\text{SO}_4 \cdot \text{PbSO}_4$.

SOLUBILITY IN WATER.

(Barre, 1901.)

t°.	Gms. $(\text{NH}_4)_2\text{SO}_4$ per 100 Gms.		Solid Phase.
	Sat. Solution.	Water.	
20	12.17	13.86	$(\text{NH}_4)_2\text{SO}_4 \cdot \text{PbSO}_4$
50	16.15	19.25	"
75	19.52	24.31	"
100	22.74	29.42	"

EQUILIBRIUM IN THE SYSTEM AMMONIUM SULFATE
PRASEODYMIUM SULFATE AND WATER AT 25°.

(Zambonini and Restaino, 1929.)

Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase
$\text{Pr}_2(\text{SO}_4)_3$	$(\text{NH}_4)_2\text{SO}_4$		$\text{Pr}_2(\text{SO}_4)_3$	$(\text{NH}_4)_2\text{SO}_4$	
0.11	43.12	$(\text{NH}_4)_2\text{SO}_4 + 1.5$	0.69	14.91	1.1.8
0.30	40.13	1.5	0.68	7.07	"
0.66	35.63	"	3.52	0.98	"
0.64	32.40	" + 1.1.8	3.55	0.53	"
0.67	19.88	1.1.8	8.24	0.50	" + $\text{Pr}_2(\text{SO}_4)_3 \cdot 8\text{H}_2\text{O}$

$$1.5 = \text{Pr}_2(\text{SO}_4)_3 \cdot 5(\text{NH}_4)_2\text{SO}_4; \quad 1.1.8 = \text{Pr}_2(\text{SO}_4)_3 \cdot (\text{NH}_4)_2\text{SO}_4 \cdot 8\text{H}_2\text{O}$$

AMMONIUM Strontium SULFATE $(\text{NH}_4)_2\text{SO}_4 \cdot \text{SrSO}_4$.

SOLUBILITY IN WATER.

(Barre, 1909.)

t°.	Gms. $(\text{NH}_4)_2\text{SO}_4$ per 100 Gms.		Solid Phase.
	Sat. Solution.	Water.	
50	43.99	78.54	$(\text{NH}_4)_2\text{SO}_4 \cdot \text{SrSO}_4 + \text{SrSO}_4$
75	45.40	83.15	"
100	46.27	66.2	"

AMMONIUM Thorium SULFATEEQUILIBRIUM IN THE SYSTEM AMMONIUM SULFATE
THORIUM SULFATE AND WATER AT 25°.

(Rosenheim and Zickermann, 1932.)

Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase
$\text{Th}(\text{SO}_4)_2$	$(\text{NH}_4)_2\text{SO}_4$		$\text{Th}(\text{SO}_4)_2$	$(\text{NH}_4)_2\text{SO}_4$	
1.46	43.13	$(\text{NH}_4)_2\text{SO}_4$	2.59	33.42	2.1.3½
1.36	42.46	" + 3.1.3	3.40	29.23	"
1.24	44.35	3.1.3	5.26	24.30	"
1.73	42.80	"	6.66	23.10	"
2.08	41.85	"	8.98	19.05	" + 1.1.5
1.83	41.53	2.1.3½	9.28	18.80	1.1.5
1.92	41.12	"	10.16	18.80	1.1.5
2.03	39.96	"	12.47	15.80	"
2.33	37.56	"	11.04	14.60	" + $\text{Th}(\text{SO}_4)_2$
			14.50	10.00	" "excess"

$$3.1.3 = 3(\text{NH}_4)_2\text{SO}_4 \cdot \text{Th}(\text{SO}_4)_2 \cdot 3\text{H}_2\text{O}; \quad 2.1.3\frac{1}{2} = 2(\text{NH}_4)_2\text{SO}_4 \cdot \text{Th}(\text{SO}_4)_2 \cdot 3\frac{1}{2}\text{H}_2\text{O};$$

$$1.1.5 = (\text{NH}_4)_2\text{SO}_4 \cdot \text{Th}(\text{SO}_4)_2 \cdot 5\text{H}_2\text{O}.$$

EQUILIBRIUM IN THE SYSTEM AMMONIUM SULFATE, URANYL SULFATE
AND WATER AT 25°.
(Colant, 1928.)

Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase
UO ₂ SO ₄	(NH ₄) ₂ SO ₄		UO ₂ SO ₄	(NH ₄) ₂ SO ₄	
0.0	43.25	(NH ₄) ₂ SO ₄	16.46	7.46	1.1.2
1.89	42.13	"	19.23	6.80	"
4.53	40.36	"	31.84	4.49	"
9.34	40.59	"	35.70	4.15	" + 1.2.5
10.00	40.65	" + 1.1.2	36.96	3.89	1.2.5
9.70	37.18	1.1.2	47.25	2.00	"
10.29	30.09	"	59.00	0.84	"
10.81	17.65	"	61.12	0.38	" + UO ₂ SO ₄ · 3H ₂ O
12.98	9.76	"	61.28	0.25	UO ₂ SO ₄ · 3H ₂ O
			61.18	0.0	"

1.1.2 = (NH₄)₂SO₄ · UO₂SO₄ · 2H₂O; 1.2.5 = (NH₄)₂SO₄ · 2UO₂(SO₄)₃ · 5H₂O.

AMMONIUM Vanadium SULFATE (Alum) (NH₄)₂V₂(SO₄)₄ · 24H₂O.

100 cc. H₂O dissolve 31.69 gms. anhydrous or 78.50 gms. hydrated salt at 25°.

AMMONIUM Zinc SULFATE (NH₄)₂Zn(SO₄)₂ · 6H₂O.

(Locke.)

SOLUBILITY IN WATER.

(Average curve,

Tabler, Locke, at 25°.)

°.	G. (NH ₄) ₂ Zn(SO ₄) ₂ per 100 Gms.		°.	G. (NH ₄) ₂ Zn(SO ₄) ₂ per 100 Gms.	
	Solution.	Water.		Solution.	Water.
0	6.54	7.0	40	16.66	20
10	8.67	9.5	50	20.0	25
20	11.11	12.5	60	23.1	30
25	12.36	14.1	70	25.9	35
30	13.79	16.0	80	29.6	42

EQUILIBRIUM IN THE SYSTEM AMMONIUM SULFATE, ZINC
SULFATE AND WATER AT 25°.

Results of Craven and Gardner, 1928

Results of Hill and Taylor, Jr., 1928

Gm. Mols. per 1000 gms. H ₂ O		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase
ZnSO ₄	(NH ₄) ₂ SO ₄		ZnSO ₄	(NH ₄) ₂ SO ₄	
0.0	5.820	(NH ₄) ₂ SO ₄	0.0	43.42	(NH ₄) ₂ SO ₄
0.0183	3.742	1.1.6	0.09	43.40	" + 1.1.6
0.0291	2.993	"	0.23	34.02	1.1.6
0.0795	1.913	"	0.47	25.24	"
0.0930	1.288	"	1.23	14.65	"
0.1708	0.8511	"	2.96	8.42	"
0.3176	0.6054	"	6.73	5.47	"
0.6220	0.4680	"	8.53	4.93	"
1.429	0.3248	"	16.07	3.29	"
2.100	0.2628	"	26.21	2.02	"
3.160	0.1703	"	36.22	0.98	" + ZnSO ₄ · 7H ₂ O
3.560	0.1313	" + ZnSO ₄ · 7H ₂ O	36.72	0.0	ZnSO ₄ · 7H ₂ O
3.571	0.0	ZnSO ₄ · 7H ₂ O			

1.1.6 = (NH₄)₂SO₄ · ZnSO₄ · 6H₂O.

Results for equilibrium in this system at 0° , 17.5° , 40.5° , 64.5° and 100° are given by Benrath, 1931. This author also gives the following values for the solubility of the double salt in water.

AMMONIUM Zinc SULFATE $(\text{NH}_4)_2\text{SO}_4 \cdot \text{ZnSO}_4 \cdot 6\text{H}_2\text{O}$.

SOLUBILITY OF AMMONIUM ZINC SULFATE IN WATER.

(Benrath, 1931.)

t°	Gms. $(\text{NH}_4)_2\text{SO}_4 \cdot \text{ZnSO}_4$ per 100 gms. H_2O	Solid Phase	t°	Gms. $(\text{NH}_4)_2\text{SO}_4 \cdot \text{ZnSO}_4$ per 100 gms. H_2O	Solid Phase
0	7.3	1.1.6	70	38.19	1.1.6
17	11.86	"	80	46.75	"
35	17.95	"	90	58.1	"
50	25.30	"	100	72.5	"

SOLUBILITY OF AMMONIUM SULFATE IN AQUEOUS ETHYL ALCOHOL SOLUTIONS.

(Traube and Neuberg — *Z. physik. Chem.* 1, 510, '87; Bodländer — *Ibid.* 7, 318, '91; Schreinemaker — *Ibid.* 23, 657, '97; de Bruyn — *Ibid.* 32, 68, '00; Lincbarger — *Am. Ch. J.* 14, 380, '92.)

Upper Layer Results. Grams per 100 Gms. Solution at 10° 40° .		Lower Layer Results. Gms. $\text{C}_2\text{H}_5\text{OH}$ per 100 Gms. Solution.			Gms. $(\text{NH}_4)_2\text{SO}_4$ per 100 g. Solution at:		
$\text{C}_2\text{H}_5\text{OH}$.	$(\text{NH}_4)_2\text{SO}_4$				6.5° .	15° .	33° .
100	0.0	0	42.0	42.6	44		
80	0.1	2.5	39.0	40.2	?		
70	0.3	5.0	36.2	37.2	?		
60	1.4	7.5	33.2	34.5	42		
50	3.2	10.0	30.0	31.0	35		
45	4.8	12.5	27.2	28.0	?		
40	6.6	15.0	24.6	25.2	?		
35	9.2	17.5	22.0	22.4	?		
30	12.2	20.0	20.0	20.0	?		
25	14.6						

SO

NOTE. — When ammonium sulfate is added to aqueous solutions of alcohol, it is found that for certain concentrations and temperatures the solutions separate into two liquid layers, the upper of which contains the larger percentage of alcohol.

Most of the determinations which have been made upon this system, as contained in the papers referred to above, are given in terms of grams of ammonium sulfate, of alcohol and of water per 100 grams of these three components taken together. Those results which are given in other terms can be readily calculated to this basis, and it is, therefore, possible to make a comparison of the several sets of determinations by plotting on cross-section paper and drawing curves through the points. In the present case the grams of alcohol per 100 grams of solution were taken as ordinates, and the grams of ammonium sulfate in the same quantity of each solution taken as abscissæ. It was found that a single curve could be drawn through practically all the points representing the upper layer solutions at the several temperatures, but the points for the solutions containing the larger amounts of water gave curves which diverged with increase of temperature. The results given for 33° in the above table are not to be accepted as correct until further work has been done.

SOLUBILITY OF AMMONIUM SULFATE IN AQUEOUS SOLUTION OF ETHYL ALCOHOL AT 30° AND AT 50°.

(Results at 30°, Wibaut, 1909; at 50°, Schreinemakers and de Baat, 1907.)

Results at 30°. Two liquid layers are formed at concentrations of alcohol between 5.8 and 62%. These have the compositions:

Upper Layer.			Lower Layer.		
Gms. per 100 Gms. Sat. Solution.			Gms. per 100 Gms. Sat. Solution.		
(NH ₄) ₂ SO ₄ .	C ₂ H ₅ OH.	H ₂ O.	(NH ₄) ₂ SO ₄ .	C ₂ H ₅ OH.	H ₂ O.
2.2	56.6	41.2	37.1	5.8	57.1
2.6	54.5	42.9	35.7	6.3	58
3.4	52.3	44.3	33.8	7.4	58.8
13.2	31.8	55	21.7	18.4	59.9
17	25	58	17	25	58

At a concentration of 62% alcohol the liquid is homogeneous and contains 1.3 gms. (NH₄)₂SO₄ per 100 gms. sat. solution. At 90.4% alcohol no (NH₄)₂SO₄ is dissolved.

Results at 50°.

Gms. per 100 Gms. Saturated Solution		
(NH ₄) ₂ SO ₄ .	C ₂ H ₅ OH.	H ₂ O.
43.02	2.32	54.66
41.1	4.1	54.8
1.2	64.5	34.3
0.2	75.5	24.3

Between the concentrations 4.1 and 64.5% C₂H₅OH the mixtures separate into two layers. The percentage composition of each member of several such conjoined layers, is as follows:

Upper Layer.			Lower Layer.		
Gms. per 100 Gms. Sat. Solution.			Gms. per 100 Gms. Sat. Solution.		
(NH ₄) ₂ SO ₄ .	C ₂ H ₅ OH.	H ₂ O.	(NH ₄) ₂ SO ₄ .	C ₂ H ₅ OH.	H ₂ O.
1.2	64.5	34.3	41.1	4.1	54.8
1.6	60	38.4	36.8	6	57.2
3.8	50	46.2	30.8	9	60.2
7.4	40	52.6	26.6	12	61.4
10	34.4	55.6	23.6	15	61.4

Two determinations at 0° by deWaal (1910) gave 30 gms. (NH₄)₂SO₄ per 100 gms. sat. solution in 9.41% alcohol and 0.14 gm. (NH₄)₂SO₄ in 73.03% alcohol. Between these concentrations of alcohol two liquid layers are formed.

100 gms. 95% formic acid dissolve 25.4 gms. (NH₄)₂SO₄ at 16.5°.

(Aschan, 1913.)

Data for the System (NH₄)₂SO₄ + H₂SO₄ + C₂H₅OH at 18° are given by Dunncliff, Aggarwal and Moon, 1928.)

F. pt. data for (NH₄)₂SO₄ + H₂SO₄ are given by Kendall and Landon, 1920, and by Cambi and Bozza, 1923.

SOLUBILITY OF AMMONIUM SULFATE IN AQUEOUS PROPYL ALCOHOL SOLUTIONS
AT 20°.

(Linebarger—Am. Ch. J. 14, 380, '92.)

Gms. per 100 Gms. Solution.		Gms. per 100 Gms. Solution.	
C ₃ H ₇ OH.	(NH ₄) ₂ SO ₄ .	C ₃ H ₇ OH.	(NH ₄) ₂ SO ₄ .
70	0.4	40	3.2
60	1.0	30	4.8
50	2.0	20	6.7

EQUILIBRIUM IN THE SYSTEM AMMONIUM SULFATE ISO PROPYL
ALCOHOL AND WATER AT 25°.
(Ginnings and Chen, 1931.)

The binodal curve of this system was determined by observing the appearance and disappearance of clouding in a mixture of weighed amounts of the salt and one of the liquids upon addition of weighed amounts of the other. A tie line, *, was located by determination of the salt in two liquid phases in contact with each other and the plait point, PP., was found by plotting.

Gms. per 100 gms. homogeneous mixture		Gms. per 100 gms. homogeneous mixture	
(NH ₄) ₂ SO ₄	iso C ₃ H ₇ OH	(NH ₄) ₂ SO ₄	iso C ₃ H ₇ OH
45.58	3.12*	8.98	18.96
31.45	6.85	5.35	24.20
22.20	9.95	3.93	27.54
18.6	11.6 PP	0.97	41.50*
14.2	14.10		

SO

EQUILIBRIUM IN THE SYSTEM AMMONIUM SULFATE, TERTIARY
BUTYL ALCOHOL AND WATER AT 30°.
(Ginnings and Robbins, 1930.)

The binodal curve, tie lines, *, and plait point, PP., for this system were determined as mentioned above.

Gms. per 100 gms. homogeneous mixture		Gms. per 100 gms. homogeneous mixture		Gms. per 100 gms. homogeneous mixture	
(NH ₄) ₂ SO ₄	ter. (CH ₃) ₃ COH	(NH ₄) ₂ SO ₄	ter. (CH ₃) ₃ COH	(NH ₄) ₂ SO ₄	ter. (CH ₃) ₃ COH
—	99 *	3.7	32.0 PP	13.0	8.9
—	82 *	4.0	28.2	14.1	7.7
0.4	63.4	4.6	24.6	18.2	5.3
—	60.0*	5.1	— *	26.1	2.5
1.4	48.8	5.7	19.8	27.4	— *
—	42 *	6.5	17.4	28.7	1.8
3.2	34.3	12.1	— *	32.1	1.4
				37.8	0.8*

In a later paper Ginnings, Herring and Webb, 1933, give the value 3.2 gms. (NH₄)₂SO₄ + 35.4 gms. ter. (CH₃)₃COH + 61.4 gms. H₂O for the plait point of this system at 25° but do not give the original results for the other points on the binodal curve.

AMMONIUM SULFATE

The binodal curves of the systems:

Ammonium Sulfate + Allyl Alcohol + Water at 25°
and Ammonium Sulfate + Pyridine + Water at 25°

have been determined respectively, by Ginnings and Deen, 1935; and Ginnings, Webb and Hinohara, 1933. The authors do not give their original experimental results but only the values of a series of arbitrary constants calculated from them by means of empirical equations. In the case of allyl alcohol it is concluded that this alcohol is more difficult to salt out than either normal or iso propyl alcohol.

EQUILIBRIUM IN THE SYSTEM AMMONIUM SULFATE, URETHAN AND WATER AT 25°.
(Palitsch, 1929, 1929.)

Gm. Mols. per 1000 gms. H ₂ O		Solid Phase	Gm. Mols. per 1000 gms. H ₂ O		Solid Phase
$(\text{NH}_4)_2\text{SO}_4$	$\text{NH}_2\text{COOC}_2\text{H}_5$		$(\text{NH}_4)_2\text{SO}_4$	$\text{NH}_2\text{COOC}_2\text{H}_5$	
5.805	0.0	$(\text{NH}_4)_2\text{SO}_4$	4.0	0.387	$\text{NH}_2\text{COOC}_2\text{H}_5$
5.778	0.029	"	3.7	0.451	lower liquid layer
5.763	0.106	" + $\text{NH}_2\text{COOC}_2\text{H}_5$	0.06	47.86	upper "
			0.0	53.09	$\text{NH}_2\text{COOC}_2\text{H}_5$

100 gms. liquid Sulfur Dioxide (SO_2) dissolve 0.067 gm. $(\text{NH}_4)_2\text{SO}_4$ at 0°.
(Jander and Wickert, 1936; Jander and Ruppolt, 1937.)

AMMONIUM PERSULFATE $(\text{NH}_4)_2\text{S}_2\text{O}_8$.

100 parts H₂O dissolve 58.2 parts $(\text{NH}_4)_2\text{S}_2\text{O}_8$ at 0°.

(Marshall, 1891.)

AMMONIUM DITHIONATE $(\text{NH}_4)_2\text{S}_2\text{O}_6 \cdot \frac{1}{2}\text{H}_2\text{O}$.

SOLUBILITY IN WATER. (de Baat, 1926)

t°	Gms. $(\text{NH}_4)_2\text{S}_2\text{O}_6$ per 100 gms. sat. sol.	Solid Phase	t°	Gms. $(\text{NH}_4)_2\text{S}_2\text{O}_6$ per 100 gms. sat. sol.	Solid Phase
0..	57.05	$(\text{NH}_4)_2\text{S}_2\text{O}_6 \cdot \frac{1}{2}\text{H}_2\text{O}$	20..	62.43	$(\text{NH}_4)_2\text{S}_2\text{O}_6 \cdot \frac{1}{2}\text{H}_2\text{O}$
10..	60.14	"	30..	64.10	"

SOLUBILITY OF AMMONIUM DITHIONATE IN AQUEOUS SOLUTIONS OF STRONTIUM DITHIONATE AT 30° AND VICE VERSA. (de Baat, 1926)

Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase
SrS_2O_6	$(\text{NH}_4)_2\text{S}_2\text{O}_6$		SrS_2O_6	$(\text{NH}_4)_2\text{S}_2\text{O}_6$	
0.98	63.73	$(\text{NH}_4)_2\text{S}_2\text{O}_6 \cdot \frac{1}{2}\text{H}_2\text{O}$	6.47	34.57	$\text{SrS}_2\text{O}_6 \cdot 4\text{H}_2\text{O}$
2.17	60.66	" + $\text{SrS}_2\text{O}_6 \cdot \frac{1}{2}\text{H}_2\text{O}$	8.79	24.52	"
2.71	56.76	$\text{SrS}_2\text{O}_6 \cdot 4\text{H}_2\text{O}$	10.74	16.55	"
4.45	45.04	"	14.90	0.0	"

SOLUBILITY OF AMMONIUM TRI AND TETRATHIONATES,
EACH SEPARATELY, IN WATER.

(Kurtenecker and Lassiö, 1926.)

Results for:

Trithionate

t°	Gms. $(\text{NH}_4)_2\text{S}_3\text{O}_6$ per 100 gms. sat. sol.
0	53.2
20	56.4
30	58.4

Tetrathionate

t°	Gms. $(\text{NH}_4)_2\text{S}_4\text{O}_6$ per 100 gms. sat. sol.
0	51.2
20	54.3
30	56.2

EQUILIBRIUM IN THE SYSTEM AMMONIUM TRITHIONATE, AMMONIUM TETRATHIONATE AND WATER.

(Kurtenacker and Laszlo, 1938.)

The tri and tetrathionates decompose while being shaken with water, especially at 20°. The decomposition products include thiosulfate, pentathionate, sulfate and free acid. Determinations are given for the percentage of pentathionate and thiosulfate. The maximum amount of thio sulfate was 0.2 percent

Results at 0°

Results at 20°

Gms. per 100 gms. sat. sol.			Solid Phase	Gms. per 100 gms. sat. sol.			Solid Phase
(NH ₄) ₂ S ₃ O ₆	(NH ₄) ₂ S ₄ O ₆	(NH ₄) ₂ S ₅ O ₆		(NH ₄) ₂ S ₃ O ₆	(NH ₄) ₂ S ₄ O ₆	(NH ₄) ₂ S ₅ O ₆	
1.2	51.0	0.0	(NH ₄) ₂ S ₄ O ₆	0.0	54.2	0.0	(NH ₄) ₂ S ₄ O ₆
1.1	48.9	0.8	"	1.0	52.9	0.0	"
15.5	30.5	3.9	"	9.0	43.3	1.6	"
27.8	21.5	0.9	"	19.6	32.2	4.5	"
41.2	16.7	0.7	"	39.9	19.0	1.8	"
46.7	76.1	0.0	(NH ₄) ₂ S ₅ O ₆	45.5	15.9	1.8	"
52.1	1.0	0.0	"	53.0	5.2	0.0	(NH ₄) ₂ S ₅ O ₆
53.0	0.9	0.0	"	56.0	2.0	0.0	"

AMMONIUM SELENITE (NH₄)₂SeO₃·H₂O.

SOLUBILITY OF AMMONIUM SELENITE IN WATER.

(Janickis, 1934; Janickis and Outmanaitis, 1936.)

t°	d. of sat. sol.	Gms. (NH ₄) ₂ SeO ₃ per 100 gms. sat. sol.	Solid Phase	t°	Gms. (NH ₄) ₂ SeO ₃ per 100 gms. sat. sol.	Solid Phase
-0.105	1.0002	0.326	Ice	- 8.5	47.18	(NH ₄) ₂ SeO ₃ ·H ₂ O
-0.260	1.0036	0.812	"	+ 1.0	49.21	"
-0.875	1.019	3.20	"	14.0	51.99	"
-2.06	1.051	7.75	"	25.0	54.70	"
-8.81	1.197	27.24	"	35.2	57.13	"
-15.95	1.297	39.88	"	43.0	59.90	"
-21.9	—	44.8	" + (NH ₄) ₂ SeO ₃ ·H ₂ O	50	62.31	"
-20.0	—	45.12	(NH ₄) ₂ SeO ₃ ·H ₂ O	70	69.08	"

AMMONIUM Pyro SELENITE (NH₄)₂Se₂O₅·3H₂O.

SOLUBILITY OF AMMONIUM PYROSELENITE IN WATER.

(Janickis, 1934; Janickis and Outmanaitis, 1936.)

t°	d. of sat. sol.	Gms. (NH ₄) ₂ Se ₂ O ₅ per 100 gms. sat. sol.	Solid Phase	t°	Gms. (NH ₄) ₂ Se ₂ O ₅ per 100 gms. sat. sol.	Solid Phase
-0.148	1.002	0.547	Ice	+15.0	66.65	(NH ₄) ₂ Se ₂ O ₅ ·3H ₂ O
-0.373	1.0075	1.36	"	20	69.50	"
-0.697	1.019	2.69	"	25	73.24	"
-1.365	1.035	5.29	"	30	79.74	"
-3.18	1.090	12.57	"	32	82.29	"
-6.23	1.178	23.35	"	32	86.23	(NH ₄) ₂ Se ₂ O ₅
-13.0	1.351	40.7	"	33.2	86.35	"
-16.9	—	49.0	" + (NH ₄) ₂ Se ₂ O ₅ ·3H ₂ O	34.0	86.43	"
-15.0	—	49.62	(NH ₄) ₂ Se ₂ O ₅ ·3H ₂ O	45.1	87.23	"
-10.0	—	52.86	"	57.2	88.78	"
0.0	—	56.84	"	70.1	90.50	"

AMMONIUM Tetra SELENITE (NH₄)H₃(SeO₃)₂.

SOLUBILITY OF AMMONIUM TETRASELENITE IN WATER.
(Janickis, 1934; Janickis and Outmanaitis, 1936.)

t°	d. of sat. sol.	Gms. (NH ₄)H ₃ (SeO ₃) ₂ per 100 gms. sat. sol.	Solid Phase	t°	Gms. (NH ₄)H ₃ (SeO ₃) ₂ per 100 gms. sat. sol.	Solid Phase
-0.147	1.002	0.549	Ice	-14.8	60.08	Ice+(NH ₄)H ₃ (SeO ₃) ₂
-0.335	1.0075	1.365	"	-10.3	64.58	(NH ₄)H ₃ (SeO ₃) ₂
-0.595	1.0165	2.71	"	-5.8	68.70	"
-1.055	1.034	5.32	"	+ 0.1	73.61	"
-2.435	1.063	12.94	"	8.8	79.30	"
-4.385	1.174	24.73	"	18.0	85.11	"
-8.06	1.345	40.89	"	30.0	91.62	"
-12.85	1.511	54.60	"			

AMMONIUM SELENATE (NH₄)₂SeO₄.

SOLUBILITY OF AMMONIUM SELENATE IN AQUEOUS SOLUTIONS
OF SELENIC ACID AT 30°.
(King, 1937.)

Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase
(NH ₄) ₂ SeO ₄	H ₂ SeO ₄		(NH ₄) ₂ SeO ₄	H ₂ SeO ₄	
55.12	0.0	(NH ₄) ₂ SeO ₄	44.74	34.52	—
53.82	3.56	"	34.41	42.50	(NH ₄) ₂ SeO ₄ ·H ₂ SeO ₄
53.03	5.39	"	24.13	50.53	"
53.22	9.08	"	23.41	50.77	"
54.40	10.75	"	20.04	55.26	—
53.11	12.73	—	18.47	58.61	(NH ₄) ₂ SeO ₄ ·H ₂ SeO ₄
50.48	14.88	3(NH ₄) ₂ SeO ₄ ·H ₂ SeO ₄	17.27	60.74	"
48.40	19.24	"	17.40	61.08	"
46.36	24.18	"	17.20	63.28	"
45.49	28.08	"	23.79	67.38	"
43.92	34.13	—	29.72	66.23	"

AMMONIUM MetaVANADATE NH₄VO₃.

SOLUBILITY IN WATER. (Lachartre, 1924.)

t°	Gms. NH ₄ VO ₃ per 100 gms. sat. sol.	t°	Gms. NH ₄ VO ₃ per 100 gms. sat. sol.
15.....	5.18	70.....	36.0
32.....	10.4	90.....	65.0
50.....	16.1		

At temperatures above 50° the results are not exact on account of the decomposition of the vanadate with loss of ammonia.

AMMONIUM BiVANADATE (NH₄)₂O(V₂O₅)₂·3H₂O.

100 gms. sat. solution in water contain 28.0 gms. (NH₄)₂O(V₂O₅)₂ at 16°.
(Lachartre, 1923.)

NOTE. — The above results by Lachartre, are about ten times too high as compared with previous determinations. The decimal points should probably be moved one place to the left.

AMMONIUM Meta VANADATE NH_4VO_3 .

SOLUBILITY IN WATER AND IN AQUEOUS AMMONIUM SALT AND AMMONIUM HYDROXIDE SOLUTIONS.

(Meyer, 1909.)

Gms. per 1000 cc. in Each Solvent.

t°.	Water.	0.05 n. NH ₄ Cl.	0.1 n. NH ₄ Cl.	0.05 n. NH ₄ NO ₃ .	0.1 n. NH ₄ NO ₃ .	0.0668 n. NH ₃ .	0.245 n. NH ₃ .	0.588 n. NH ₃ .
18	4.35	1.66	0.41	1.67	0.58	5.58	7.97	12.06
25	6.08	2.63	1.17	2.77	1.23	7.06	8.58	12.66
35	10.77	5.21	2.69	...	...	...	...	...
45	15.71	8.88	5.40	...	...	...	...	...
55	19.97	11.18	7.40	...	...	...	...	...
70	30.47	...	...	...	...	...	...	...

100 cc. anhydrous hydrazine dissolve 2 gms. ammonium metavanadate at room temp.
(Welsh and Broderson, 1915.)

AMMONIUM Para WOLFRAMATE (Tungstate) $5(\text{NH}_4)_2\text{O} \cdot 12\text{WO}_3 \cdot 11\text{H}_2\text{O}$.

SOLUBILITY OF AMMONIUM PARA WOLFRAMATE IN WATER.

(Rosenheim and Wolff, 1936.)

t°	Gms. $5(\text{NH}_4)_2\text{O} \cdot 12\text{WO}_3$ per 100 gms. sat. sol.	Solid Phase	t°	Gms. $5(\text{NH}_4)_2\text{O} \cdot 12\text{WO}_3$ per 100 gms. sat. sol.	Solid Phase
17	1.064	$5(\text{NH}_4)_2\text{O} \cdot 12\text{WO}_3 \cdot 11\text{H}_2\text{O}$	49	4.341	$5(\text{NH}_4)_2\text{O} \cdot 12\text{WO}_3 \cdot 11\text{H}_2\text{O}$
25	1.586	"	53	3.280	$5(\text{NH}_4)_2\text{O} \cdot 12\text{WO}_3 \cdot 7\text{H}_2\text{O}$
29	2.014	"	62	6.145	"
35	2.424	"	70	7.971	"
45	3.467	"			

NITROUS OXIDE N_2O .

SOLUBILITY IN WATER.

(Bunsen; Roth, 1897; Knopp, 1904; Geffcken, 1904.)

t°.	Coefficient of Absorption β		q .	Solubility in Terms of Ostwald Expression (l.).*		
	(B.)	(R.)		(R.)	(K.)	(G.)
5	1.0954	1.1403	0.205	1.161	...	1.067
10	0.9196	0.9479	0.171	0.9815	...	0.9101
15	0.7778	0.7896	0.143	0.8315	...	0.7784
20	0.6700	0.6654	0.121	0.7131	0.6739	0.6756
25	0.5901	0.5752	0.104	0.6281	...	0.5942

* Calculated by Geffcken.

NOTE. — Knopp and also Geffcken call attention to the fact that Roth in making his determinations used a rubber tube between the gas burette and the shaking flask, and give this as an explanation of the high results which he obtained.

β = the Bunsen Absorption Coefficient which shows the volume of gas (reduced to 0° and 760 mm pressure) absorbed by one volume of the solvent when the pressure of the gas itself without that of the solvent is 760mm.

g = the weight of gas in grams which is taken up by 100 gms. of the pure solvent at the indicated temperature and a total pressure of 760mm.

l = the Ostwald Solubility Expression which is the ratio of the volume (v) of gas absorbed at any temperature and pressure, to the volume (V) of the absorbing liquid. The solubility l is therefore the volume of gas dissolved by unit volume of solvent at the temperature of the experiment.

The solubility of Nitrous Oxide in Water at 25° , in terms of the Bunsen Absorption Coefficient, was found by Orcutt and Sievers, 1936 to be 0.549. Their value for the solubility of N_2O in blood at 25° is 0.416, which is in good agreement with the previous result of Siebeck, 1909. Additional results for blood are given by Findlay and Creighton, 1910-1911. Orcutt and Sievers made use of the Van Slyke and Neill, 1924, manometric apparatus which is based upon the principal of extracting the gas from the solvent and measuring its pressure. By means of a special technique and method of calculating the correction for unextracted gas, this becomes a simple method of determining the solubility of any gas in any liquid without the aid of previously determined constants.

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SOLUBILITY OF NITROUS OXIDE (N_2O) IN AQUEOUS SOLUTIONS OF ACIDS AT 25° .
(Manchot, Jahrestorfer and Zepler, 1924.)

Acid.	d_{25}^w of aq. acid.	Gms. acid per 100cc sol.	Abs. coef. α per 100cc sol.	Acid	d_{25}^w of aq. acid	Gms. acid per 100cc sol.	Abs. coef. α per 100cc sol.
HNO_3 ...	1.0351	6.932	51.1	H_2SO_4 ...	1.0680	11.684	44.2
" ...	1.0731	14.242	55.1	" ...	1.1630	26.974	38.7
" ...	1.1191	22.938	56.2	" ...	1.2687	45.415	38.2
HCl	1.0168	3.9387	51.2	" ...	1.3363	58.853	39.9
"	1.0335	7.7318	50.1				
"	1.0741	16.703	49.9	H_3PO_4 ...	1.0593	11.473	46.4
"	1.1050	23.706	52.1	" ...	1.0964	18.631	43.8
HIO_4	1.1740	20.421	38.7	" ...	1.2557	49.520	35.3
"	1.4066	47.023	23.8				

Absorption Coefficient α in the above table is the same as the Bunsen Coefficient β which is the volume of gas (reduced to 0° and 760 mm pressure) absorbed by one volume of the solvent when the partial pressure of the gas equals 760 mm mercury.

NITROGEN OXIDE (ous) N_2O .SOLUBILITY OF NITROUS OXIDE IN AQUEOUS SOLUTIONS OF SALTS AT 25°.
(Manchot, Jahrestorfer and Zepter, 1924.)

Salt.	d_{25} of salt solution.	Gms. anhy. salt per 100 cc. solution.	Abs. coef. α for 100 cc. solution.	Salt.	d_{25} of salt solution.	Gms. anhy. salt per 100 cc. solution.	Abs. coef. α for 100 cc. solution.
None ($=H_2O$).	—	0.0	53.14	Mg(NO ₃) ₂ .	1.0935	14.389	39.2
NH ₄ Cl.....	1.0146	5.724	46.6	"	1.1846	28.630	28.5
"	1.0312	12.037	41.1	Ca(NO ₃) ₂ ..	1.1503	22.398	32.2
"	1.0594	23.005	34.7	"	1.2927	44.796	19.4
KCl.....	1.0334	5.8157	45.3	Zn(NO ₃) ₂ .	1.1223	15.909	39.7
"	1.0540	9.3200	41.0	"	1.2433	31.818	29.1
"	1.0850	14.763	35.5	Gd(NO ₃) ₂ .	1.1435	18.465	35.0
"	1.1385	23.934	28.1	"	1.2874	36.93	27.0
"	1.1734	30.123	24.0	Cu(NO ₃) ₂ .	1.1028	12.944	35.6
NaCl.....	1.0438	6.723	39.0	"	1.2049	25.888	27.8
"	1.0874	13.504	28.5	Al(NO ₃) ₃ .	1.0703	10.22	36.1
"	1.1600	25.255	17.2	"	1.1414	20.44	29.3
CaCl ₂	1.0786	10.322	33.9	(NH ₄) ₂ SO ₄ .	1.0896	17.786	27.1
"	1.1665	22.087	20.2	"	1.1393	28.807	17.5
BaCl ₂	1.1090	12.914	37.4	K ₂ SO ₄	1.0762	10.440	35.5
"	1.2290	27.348	26.1	Na ₂ SO ₄ ...	1.0550	6.600	36.5
NH ₄ Br.....	1.0535	10.225	47.4	"	1.1141	13.879	24.8
"	1.1088	20.745	42.3	MgSO ₄ ...	1.0992	10.835	29.5
"	1.2122	40.803	35.8	"	1.1925	21.430	15.9
KBr.....	1.0891	13.211	43.0	ZnSO ₄	1.1403	15.337	29.9
"	1.1752	25.590	35.1	"	1.2699	29.705	16.9
"	1.3380	49.969	24.7	MnSO ₄ ...	1.1226	14.194	30.6
NaBr.....	1.0849	11.578	40.1	"	1.2460	29.143	17.0
"	1.1645	22.334	30.9	FeSO ₄	1.1017	10.938	34.0
"	1.3338	45.902	17.8	"	1.2011	21.845	21.6
NH ₄ NO ₃	1.0249	7.125	49.8	CoSO ₄	1.1131	12.217	27.5
"	1.0527	14.809	46.4	"	1.2218	24.433	17.1
"	1.1040	29.038	40.9	NiSO ₄	1.1355	14.499	24.6
"	1.2116	54.236	30.8	"	1.2642	28.998	13.8
KNO ₃	1.0586	10.313	44.8	Al ₂ (SO ₄) ₃ .	1.1558	17.688	22.4
"	1.1231	21.739	38.3	"	1.2381	27.875	13.4
NaNO ₃	1.0560	9.181	42.3	Fe ₂ (SO ₄) ₃ .	1.2240	26.390	25.9
"	1.0677	11.136	40.3	"	1.4319	52.781	13.1
"	1.1141	18.447	33.5	Cr ₂ (SO ₄) ₃ .	1.1657	22.356	31.8
"	1.1543	25.588	27.7	"	1.3280	44.712	18.2
"	1.2152	35.704	21.6	Na ₂ HPO ₄ .	1.0470	5.661	37.6
				Na ₃ PO ₄ ...	1.0348	3.6088	40.7
				KIO ₃	1.0008	0.3608	52.1

SOLUBILITY OF NITROUS OXIDE IN AQUEOUS SULPHURIC ACID.

(Lunge — Ber. 14, 2188, '81, see also Geffcken's results.)

Sp. Gr. of H_2SO_4	1.84	1.80	1.705	1.45	1.25
Vols. N_2O dissolved by 100 vols. H_2SO_4	75.7	66.0	39.1	41.6	33.0

100 vols. of KOH solution of 1.12 Sp. Gr. absorb 18.7 vols. N_2O .100 vols. of NaOH solution of 1.10 Sp. Gr. absorb 23.1 vols. N_2O .SOLUBILITY OF NITROUS OXIDE IN AQUEOUS SOLUTIONS OF ACIDS.
(Geffcken)

Results in terms of the Ostwald Solubility Expression (l). p. 1136

In Hydrochloric Acid. In Nitric Acid. In Sulphuric Acid.

Gms. HCl per Liter.	N_2O Dissolved		Gms. HNO_3 per Liter.	N_2O Dissolved		Gms. H_2SO_4 per Liter.	N_2O Dissolved	
	l_{15}	l_{25}		l_{15}	l_{25}		l_{15}	l_{25}
18.22	0.755	0.577	36.52	0.777	0.597	24.52	0.734	0.566
36.45	0.738	0.568	63.05	0.777	0.602	40.04	0.609	0.543
72.90	0.716	0.557	126.10	0.775	0.611	98.08	0.645	0.509
						147.12	0.602	0.482
						196.16	0.562	0.463

0

SOLUBILITY OF NITROUS OXIDE IN AQUEOUS SOLUTIONS OF:
(Roth)

Phosphoric Acid.

Oxalic Acid.

t°	Coefficient of Abs. in H_3PO_4 Solutions of:					Coefficient of Abs. in (COOH) $_2$ Solutions of:	
	3.38%.	4.72%.	8.84%.	9.80%.	13.15%.	0.812%.	3.70%.
5	1.057	1.0365	0.9883	0.9635	0.9171	1.1450	1.1094
10	0.8827	0.8665	0.8296	0.8101	0.7711	0.9526	0.9264
15	0.7388	0.7258	0.6977	0.6826	0.6505	0.7940	0.7745
20	0.6253	0.6147	0.5926	0.5810	0.5555	0.6694	0.6538
25	0.5427	0.5329	0.5143	0.5054	0.4860	0.5784	0.5643

SOLUBILITY OF NITROUS OXIDE IN ALCOHOL AND IN AQUEOUS CHLORAL
HYDRATE SOLUTIONS AT 20°.

(Bunsen; Knapp — Z. physik. Ch. 48, 106, '04)

t°.	In Alcohol (B.).		In Aq. Chloral Hydrate (K.).		
	Vols. N_2O (at 0° and 760 mm.) per 1 Vol. Alcohol.		Normality of $\text{C}_2\text{HCl}_3\text{O} \cdot \text{H}_2\text{O}$	Gms. $\text{C}_2\text{HCl}_3\text{O} \cdot \text{H}_2\text{O}$ per Liter.	Coeff. of Abs. of N_2O .
0	4.178		0.184	30.43	0.618
5	3.844		0.445	73.60	0.613
10	3.541		0.942	155.8	0.596
15	3.268		1.165	192.7	0.589
20	3.025		1.474	243.8	0.579
24	2.853		1.911	316.4	0.567

SOLUBILITY OF NITROUS OXIDE IN PETROLEUM. COEFFICIENT OF
ABSORPTION AT 10° = 2.49, AT 20° = 2.11.

(Gniiewaz and Wallisz — Z. physik. Ch. 1, 70, '87)

SOLUBILITY OF NITROUS OXIDE IN AQUEOUS SALT SOLUTIONS.

Results by Gordon in terms of coefficient of absorption. page 1136

Salt.	Concentration of Salt.		Coefficient of Absorption of N_2O at:			
	Grams per 100 Grams Solution.	Gram Mols. per Liter.	5°.	10°.	15°.	20°.
Calcium Chloride	5.79	0.547	0.819	0.697	0.591	0.500
"	9.86	0.964	0.668	0.586	0.509	0.435
"	13.99	1.416	0.510	0.441	0.380	0.328
Lithium Chloride	1.35	0.319	0.986	0.831	0.700	0.594
"	3.85	0.928	0.878	0.743	0.629	0.536
"	11.48	2.883	0.606	0.512	0.437	0.382
Lithium Sulphate	2.37	0.219	0.934	0.792	0.670	0.569
"	5.46	0.521	0.795	0.665	0.557	0.474
"	8.56	0.836	0.646	0.555	0.477	0.415
Magnesium Sulphate	5.90	0.521	0.766	0.664	0.561	0.471
"	7.66	0.687	0.708	0.586	0.488	0.414
"	10.78	0.997	0.569	0.491	0.417	0.346
Potassium Chloride	4.90	0.676	0.879	0.751	0.643	0.555
"	7.64	1.037	0.799	0.693	0.591	0.494
"	14.58	2.147	0.654	0.574	0.500	0.430
"	22.08	3.414	0.544	0.459	0.390	0.339
Potassium Sulphate	2.62	0.154	0.986	0.831	0.701	0.605
"	4.78	0.285	0.918	0.763	0.637	0.542
Sodium Chloride	6.20	1.107	0.800	0.682	0.585	0.509
"	8.88	1.614	0.713	0.603	0.510	0.434
"	12.78	2.391	0.634	0.532	0.449	0.386
Sodium Sulphate	5.76	0.427	0.808	0.677	0.584	0.495
"	8.53	0.646	0.692	0.574	0.482	0.416
"	12.44	0.974	0.559	0.486	0.417	0.354
Strontium Chloride	3.31	0.215	0.928	0.788	0.671	0.578
"	5.73	0.380	0.848	0.709	0.610	0.550
"	13.24	0.939	0.644	0.547	0.463	0.390

Results by Knopp, in terms of the coefficient of absorption.

Salt.	Formula.	Conc. of Salt per Liter.		Coef. of Absorption of N_2O at 20°.
		Normality.	Grams.	
Potassium Nitrate	KNO_3	0.1061	10.74	0.6173
"	"	0.2764	27.94	0.6002
"	"	0.5630	56.97	0.5713
"	"	1.1683	118.2	0.5196
Sodium Nitrate	$NaNO_3$	0.1336	11.37	0.6089
"	"	0.3052	25.97	0.5876
"	"	0.6286	53.50	0.5465
"	"	1.1200	95.30	0.4926

SOLUBILITY OF NITROUS OXIDE IN AQUEOUS SALT SOLUTIONS.

Results by Geffcken in terms of the Ostwald expression (*D.*, page 1136)

Salt.	Formula.	Conc. of Salt per Liter		Solubility of N_2O .	
		Gram Equiv.	Grams	l_{25}	l_{20}
Ammonium Chloride	NH_4Cl	0.5	26.76	0.730	0.557
Ammonium Chloride	NH_4Cl	1.0	53.52	0.691	0.529
Caesium Chloride	$CsCl$	0.5	84.17	0.710	0.544
Lithium Chloride	$LiCl$	0.5	21.24	0.607	0.535
Lithium Chloride	$LiCl$	1.0	42.48	0.623	0.483
Potassium Bromide	KBr	0.5	59.55	0.697	0.536
Potassium Bromide	KBr	1.0	119.11	0.627	0.485
Potassium Chloride	KCl	0.5	37.3	0.686	0.527
Potassium Chloride	KCl	1.0	74.6	0.616	0.475
Potassium Iodide	KI	0.5	83.06	0.702	0.541
Potassium Iodide	KI	1.0	166.12	0.633	0.492
Potassium Hydroxide	KOH	0.5	28.08	0.668	0.514
Potassium Hydroxide	KOH	1.0	56.16	0.559	0.436
Rubidium Chloride	$RbCl$	0.5	60.47	0.695	0.533
Rubidium Chloride	$RbCl$	1.0	120.95	0.625	0.483

Results by Roth, in terms of the coefficient of absorption.

0

Grams NaCl per 100 Grams Solution.	Coefficient of Absorption of N_2O at:				
	5°.	10°.	15°.	20°.	25°.
0.99	1.0609	0.8812	0.7330	0.6191	0.5363
1.808	1.0032	0.8383	0.7026	0.5962	0.5190
3.886	0.9131	0.7699	0.6495	0.5520	0.4775
5.865	0.8428	0.7090	0.5976	0.5088	0.4424

SOLUBILITY OF NITROUS OXIDE IN AQUEOUS SOLUTIONS OF PROPIONIC ACID AT 20°.

(Knapp)

Gms. C_2H_5COOH per liter	15.15	60.42	158.4	176.6	344.0
Coef. of Absorp- tion of N_2O	0.6323	0.6369	0.6504	0.6544	0.7219

SOLUBILITY OF NITROUS OXIDE IN AQUEOUS SOLUTIONS OF GLYCEROL AND OF UREA.
(Roth, 1897)

t°.	Coefficient of Absorption of N_2O in Glycerol Solutions of			
	3.46 Per cent.	6.25 Per cent.	12.12 Per cent.	16.14 Per cent.
5	1.097	1.055	0.999	0.959
10	0.917	0.887	0.841	0.810
15	0.767	0.745	0.710	0.686
20	0.647	0.630	0.605	0.585
25	0.556	0.542	0.527	0.508

t°.	Coefficient of Absorption of N_2O in Urea Solutions of				
	3.31 per cent.	4.97 per cent.	6.47 per cent.	7.90 per cent.	9.22 per cent.
5	1.104	1.096	1.088	1.101	1.069
10	0.921	0.920	0.909	0.921	0.901
15	0.771	0.773	0.761	0.772	0.761
20	0.653	0.656	0.644	0.655	0.651
25	0.569	0.567	0.559	0.570	0.569

SOLUBILITY OF NITROUS OXIDE IN AQUEOUS SOLUTIONS OF GLYCEROL.

(Henkel, 1905, 1912.)

Results at 15°.		Results at 20°.	
Per cent Glycerol.	Absorption Coef. α .	Per cent Glycerol.	Absorption Coef. α .
0	0.7327	0	0.6288
2.49	0.7181	2.36	0.6131
3.28	0.7103	4.88	0.5993
7.17	0.6844	6.88	0.5903
10.52	0.6668	9.86	0.5633
14.05	0.6410	15.82	0.5315
17.08	0.6229		

Data for the influence of colloids and fine suspensions on the solubility of nitrous oxide in water at 25° are given by Findlay and Creighton (1910), and Findlay and Howell (1914).

Results for solutions of ferric hydroxide, dextrin, arsenious sulfide, starch, gelatin, glycogen, egg albumen, serum albumen, silicic acid and suspensions of charcoal and of silica are given.

SOLUBILITY OF NITROUS OXIDE IN AQUEOUS SOLUTIONS OF UREA AT 23°.

(Manchot, Jahrestorfer and Zepter, 1924;

d_{25}^4 of aq. sol. of Urea.	Mol. CO (NH ₂) ₂ per 1000 cc. sol.	Abs. coef. α * per 100 cc. sol.
1.0134.....	0.97	51.0
1.0287.....	1.95	49.2
1.0619.....	4.05	46.3
1.0905.....	5.89	44.5

*see page 1136

SOLUBILITY OF NITROUS OXIDE IN SEVERAL ORGANIC SOLVENTS.

(Horvaci, 1928, 1931.)

t°	cc N ₂ O per 1cc solvent (Ostwald Solubility Expression) in:				
	Carbon Tetrachloride	Chloro Benzene	Benzene	Acetone	Methyl Acetate
- 1.4	—	—	—	9.30	—
+10	5.26	3.891	4.453	7.64	8.035
15	4.89	3.638	—	—	—
20	4.57	3.382	—	—	—
25	4.285	3.174	3.686	5.95	6.27
30	4.005	2.981	—	—	—
35	3.775	2.801	—	—	—
40	3.565	2.650	3.123	4.73	4.95
45	—	2.520	—	—	—
50	—	2.400	—	—	—
55	—	2.279	—	—	—

SOLUBILITY OF NITROUS ACID IN WATER AND IN ORGANIC SOLVENTS.
(Kunze, 1922.)

An apparatus similar to that of Mc Daniel (*J. Phys. Chem.*, 15, 587, 1911) was used. The N_2O was frozen by means of liquid air and ethyl alcohol and all other gases pumped off. The N_2O sublimed from the frozen gas was dried over P_2O_5 . Its density was found to be 1.968 gms. per liter at standard temp. and pressure. In the present determinations the N_2O was sat. with the vapor of the solvent before being shaken with the solvent for the solubility determination. Hence it was not necessary to allow for the vapor pressure of the solvent.

Cc. N_2O dissolved per 1 cc. solvent both at same temp. and pressure) at 1

Solvent.	18°.	20°.	25°.	32°.	36°.	40°.	50°.	60°.	70°.	80°.
(1)...	0.703	0.675	0.638	0.617	0.587	0.561	0.530	0.513	0.478	0.449
(2)...	6.30	6.03	5.78	5.50	5.21	4.84	4.46	4.07	3.66	3.26
(3)...	5.00	4.85	4.70	4.55	4.39	4.25	4.11	3.98	3.84	3.75
(4)...	—	3.58	3.50	3.45	3.41	3.35	3.29	3.10	3.02	2.94
(5)...	3.38	3.32	3.27	3.23	3.19	3.07	2.98	2.88	—	—
(6)...	3.07	2.99	2.91	2.85	2.77	2.68	2.61	2.52	2.43	2.33
(7)...	3.23	3.15	3.07	3.00	2.93	2.85	2.78	2.72	2.65	2.57
(8)...	1.50	1.48	1.45	1.42	1.40	1.37	1.35	1.32	1.31	1.28
(9)...	5.24	5.14	5.05	4.94	4.84	4.74	4.60	4.49	4.39	4.30
(10)...	2.87	2.81	2.75	2.69	2.64	2.58	2.52	2.46	2.42	2.37
(11)...	2.52	2.47	2.43	2.37	2.32	2.27	2.24	2.19	2.16	2.12
(12)...	5.70	5.60	5.51	5.46	5.40	5.34	5.27	5.20	5.03	4.90

(1) Water.

(2) Acetone.

(3) Acetic acid.

(4) Pyridine.

(5) Methyl Alcohol.

(6) Ethyl Alcohol.

(7) Benzaldehyde.

(8) Aniline.

(9) Amyl Acetate.

(10) Ethylene Bromide.

(11) Iso Amyl Alcohol.

(12) Chloroform.

One liter cyclohexanol ($C_6H_{12}OH$) dissolve 215.84 cc Nitrous oxide (N_2O) at 26° and 766mm pressure. ^aCauquil, 1927.

NITROGEN OXIDE (ic) NO .

SOLUBILITY IN WATER.

(Winkler, 1901.)

t°.	β .	β' .	g .	t°.	β .	β' .	g .
0	0.0738	0.0734	0.0084	40	0.0351	0.0325	0.00440
5	0.0646	0.0641	0.00860	50	0.0315	0.0277	0.00376
10	0.0571	0.0564	0.00757	60	0.0295	0.0247	0.00324
15	0.0515	0.0506	0.00680	70	0.0281	0.0195	0.00267
20	0.0471	0.0460	0.00618	80	0.0270	0.0144	0.00199
25	0.0430	0.0419	0.00564	90	0.0265	0.0082	0.00114
30	0.0400	0.0384	0.00517	100	0.0264	0.0000	0.00000

β is the Bunsen Absorption Coefficient which shows the volume of gas (reduced to 0° and 760 mm) absorbed by one volume of the liquid when the pressure of the gas less that of the liquid is 760mm.

β' is the volume of gas (reduced to 0° and 760mm) which is absorbed by one volume of the liquid when the total pressure is 760 mm.

g is the weight of gas in grams dissolved by 100 gms. of solvent at the indicated temperature and total pressure of 760 mm.

SOLUBILITY OF NITRIC OXIDE IN AQUEOUS SULPHURIC ACID SOLUTIONS AT 18°.

(Lunge, 1885; Tower, 1906.)

Wt. per cent H_2SO_4 in Solution.	Sp. Gr. at 15°.	Tension of H_2O Vapor.	Solubility Coefficient * of NO at 18°.	
98	1.84	...	0.0227	(0.035, L.)
90	1.82	0.1 mm.	0.0193	
80	1.733	0.4 "	0.0117	
70	1.616	1.5 "	0.0113	
60	1.503	3.1 "	0.0118	(0.017, L.)
50	1.399	6.2 "	0.0120	

* Volume of NO (at 760 mm.) per 1 volume of aqueous H_2SO_4 .

Subsequent determinations at 20° by Pinkus and Jacobi, 1927, gave the following results:

Wt. percent H_2SO_4	cc NO (at 0° and 760 mm.) per 1.0 cc aq. H_2SO_4
43.8	0.0136
54.6	0.0125
64.1	0.0066

NITROGEN OXIDE (ic) NO.

SOLUBILITY OF NITRIC OXIDE IN AQUEOUS SOLUTIONS OF SULFURIC ACID AT 0°. (Manchot and Reinburger, 1926.)

Gms. H_2SO_4 per 100 gms. sol.	Cc. NO dissolved per		Gms. H_2SO_4 per 100 gms. sol.	Cc. NO dissolved per	
	100 gms. sol.	100 cc. sol.		100 gms. sol.	100 cc. sol.
0.0	7.38	7.38	76.7	1.8	3.1
8.8	6.5	6.9	78.0	1.9	3.2
18.2	5.2	5.9	88.3	2.0	3.5
28.0	4.5	5.4	89.1	2.1	3.7
38.6	3.8	4.9	90.0	2.3	4.1
48.0	2.9	4.0	90.4	2.4	4.3
52.6	2.4	3.4	91.9	2.4	4.3
58.7	2.2	3.3	92.4	2.5	4.6
66.5	1.9	3.0	95.0	3.8	7.1
70.8	1.9	3.0	95.9	4.2	7.7

The values are given with reference to the Dalton law.

SOLUBILITY OF NITRIC OXIDE IN ALCOHOL.

(Bunsen.)

t°	0°	5°	10°	15°	20°	24°
Vols. NO* absorbed by 1 vol. Alc.	0.316	0.300	0.286	0.275	0.266	0.261

* At 0° and 760 mm.

Data for the solubility of nitric oxide in aqueous solutions of $FeSO_4$, $NiSO_4$, $CoSO_4$ and $MnCl_2$ at 20° are given by Usher (1908); Hüfner (1907) and Manchot and Zecheulmayer (1906).

The abs. coef. β for N in sat. aq. $NiSO_4$ at 20° is 0.0245; for sat. $CoSO_4$ it is 0.0288 and for sat. aq. $MnCl_2$ it is 0.0082.

NITROGEN OXIDE

SOLUBILITY OF NITRIC OXIDE IN ORGANIC SOLVENTS, IN TERMS
OF THE OSTWALD SOLUBILITY EXPRESSION. *

(Klemen. and Epither-Wemann, 1979.)

Results for:

Benzene		Nitrobenzene		Carbon Tetrachloride	
t°	l	t°		t°	l
8.8	0.275	20	0.188	8.8	0.339
14.6	0.284	40	0.190	14.6	0.345
24.6	0.300	60	0.193	24.6	0.375
34.6	0.318	90	0.188		

Data for the Solubility of Nitric Oxide in nitrosyl chloride (NOCl), pentane and in toluene are given by Trautz and Gerwig, 1925.

Freezing-point data are given for mixtures of:

- Nitric Oxide + Methyl Ether (Baume and Germann, 1914.)
 " " + Brom benzene (Bassal and Garnier, 1921.)
 " " + Nitrogen Tetroxide (NO₂) (v. Witteroff, 1904.)

Results for vapor pressures and the temperature - composition equilibrium in the system NO + NO₂ are given by Purcell and Cheesman, 1932.

Data for equilibrium between nitrogen monoxide, dioxide and trioxide, showing the range of existence of N₂O₃ in the stoichiometric gas mixture, are given by Abel and Probst, 1929.

*see page 1136

NITROGEN PEROXIDE N₂O₄FREEZING-POINTS OF MIXTURES OF NITROGEN PEROXIDE AND NITROGEN TRIOXIDE.
(Baume and Robert, 1919.)

An apparatus made entirely of glass was used. The vapor tension of the mixture N₂O₄ + N₂O₃ + NO was also determined. Pure nitrous anhydride (N₂O₃) exists in the solid or liquid state under pressure of NO only at very low temperatures. Above -100° it dissociates and the liquid phase gets richer in N₂O₄ and the gaseous in NO. A single eutectic, near the freezing point of N₂O₃ was found for the system N₂O₄ + N₂O₃.

t° of f. pt.	Wt. per cent N ₂ O ₃ in mixture.	t° of f. pt.	Wt. per cent N ₂ O ₃ in mixture.	t° of f. pt.	Wt. per cent N ₂ O ₃ in mixture.
-11.5....	0.0	-17.4....	33.8	-50.....	59.7
-15.6....	10.9	-31.0....	47.6	-55.0....	73.4
-19.9....	18.9	-41.0....	42.9	-62.....	80.1
-20.5....	20.2	-47.5....	45.9	-102.....	86.3
-22.0....	23.5	-41.5....	51.9	-102.....	91.8
-26.0....	30.4	-43.0....	53.4	-100.....	97.0

Results for the temperatures of the freezing-points and the region of separation into two liquid layers in the system $N_2O_3 + H_2O$ and the pseudo binary system $N_2O_4 + H_2O$ are given by Lowry and Lemon, 1936. Similar results for the formation of two liquid layers in Mixtures of Nitrogen Peroxide and water ($N_2O_4 + H_2O$) are given by Lowry, Lloyd and Lloyd, 1936.

Freezing-point data for the system $N_2O_4 + N_2O_5$ are given by Lowry and Lemon, 1935.

Freezing-point data for the system $N_2O_4 + HNO_3$ are given by Berl and Saenger, 1929.

Results for the solubility of nitrogen tetroxide in aqueous ferrous bromide solutions are given by Thomas, 1896.

Freezing-points are given for mixtures of:

N_2O_4 + Bromoform ($CHBr_3$)	(Pascal, 1923.)
" + Chloroform ($CHCl_3$)	" "
" + Methyl Iodide (CH_3I)	" "
" + Carbon Tetrachloride (CCl_4)	" "
" + Nitro Trichlor Methane (CCl_3NO_2)	" "
" + Brom benzene (C_6H_5Br)	" "
" + 2,4,6 Tri nitro toluene ($C_6H_2CH_3(NO_2)_3$)	(Pascal, 1923.)
" + o Nitro toluene ($C_6H_4CH_3NO_2$)	(Breithaupt.)
" + Camphor ($C_{10}H_{16}O$)	(Pascal, 1923; Pascal and Garnier, 1923.)
NO_2 + Sulfur Dioxide (SO_2)	Terres and Constantinescu, 1934.)

NITROSYL SULFURIC ACID $HO.SO_2.O.NO$.

SOLUBILITY OF NITROSYL SULFURIC ACID IN STRONG SOLUTIONS OF SULFURIC ACID: (Elliott, Kleist, Wilkins and Webb, 1926.)

Constant agitation in a thermostat was employed.

	Gms. $HO.SO_2.O.NO$ per 100 gms. 'sat. solution in aq. H_2SO_4 of						
t°.	56.7 %.	62.1 %.	73.1 %.	74.9 %.	81.1 %.	90.1 %.	99.8 %.
0....	-	11.9	17.3	19.7	30.5	35.1	-
20.9...	19.3	22.6	27.0	31.4	42.4	49.2	62.0
37.3...	29.9	34.3	39.4	40.8	50.2	58.5	66.1
49.6...	35.6	39.3	46.4	46.2	56.5	61.6	67.8

SODIUM Na.

SOLUBILITY IN LIQUID AMMONIA.
(Ruff and Geisel, 1906.)

t°.	Mols. NH_3 Required to Dissolve 1 Gm. Atom Na.	t°.	Mols. NH_3 Required to Dissolve 1 Gm. Atom Na.
-105	4.98	-30	5.52
-70	5.20	0	5.87
-50	5.39	+22	6.14

SOLUBILITY OF SODIUM IN MELTED SODIUM HYDROXIDE.
(von Hevesy, 1909.)

t°.	480°	600°	610°	670°	760°	800°
Gms. Na per 100 Gms. NaOH	25.3	10.1	9.9	9.5	7.9	6.9

Saturation could not be reached at temperatures below 480°. The saturated mixtures were cooled by plunging the container in water and the solidified contents analyzed.

SOLUBILITY OF SODIUM IN MELTED SODIUM HYDROXIDE CONTAINING OTHER METALS AT 480°.
(von Hevesy, 1909.)

Added Metal.	Gms. Added Metal per 100 Gms. NaOH.	Gms. Dissolved Na per 100 Gms. Solvent.	Added Metal.	Gms. Added Metal per 100 Gms. NaOH.	Gms. Dissolved Na per 100 Gms. Solvent.
Thallium	5.40	23.13	Cadmium	2.87	24.34
"	8.30	23.54	"	3.16	24.29
"	12.42	21.29	Gold	6.03	23.92
"	31.37	20.91	"	8.22	23.39
			Zinc	30.37	25.38

SODIUM Na.

SOLUBILITY OF SODIUM IN AMMONIA.

(Kraus and Lucasse, 1922.)

t°.	Mol. % Na.	t°.	Mol. % Na.	t°.	Mol. % Na.	t°.	Mol. % Na.
-59.7...	1.62	-47.5...	2.50	-41.7...	3.83	-44.4...	5.47
-55.9...	1.81	-46.4...	2.64	-41.6...	4.18	-47.4...	6.27
-51.9...	2.09	-44.6...	2.87	-41.8...	4.46	-51.0...	7.09
-48.6...	2.38	-42.8...	3.18	-42.5...	4.97	-60.0...	8.34

Data for the system Na + Sn are given by Hume-Rothery, 1908.

SODIUM AMIDE NaNH_2

100 gms. Liquid Ammonia dissolve 0.004 gm. NaNH_2 at 0°. (Hunt and Boncyk, 1933.)

SODIUM ALUMINATES $\frac{1}{2}\text{Na}_2\text{O} \cdot 3\text{Al}_2\text{O}_3 \cdot 16\text{H}_2\text{O}$, $\frac{1}{4}\text{Na}_2\text{O} \cdot \text{Al}_2\text{O}_3 \cdot 10\text{H}_2\text{O}$.EQUILIBRIUM IN THE SYSTEM Na_2O , Al_2O_3 AND H_2O AT 30°.

(Goudriaan, 1922.)

Three samples of highly purified hydrated aluminium hydroxide were prepared, and from these three dehydrated samples were made by prolonged heating at 300° to 400°. Great difficulty was experienced in obtaining equilibrium due to the different forms of the hydroxide and to the viscosity of the Na OH solutions. An effort was made to determine the solid phase in each case by the "rest" method. The mixtures were agitated in many cases for periods of 2 to 3 months. At the lower concentrations of Na OH quite irregular results were obtained. The authors results were plotted and the following approximate values obtained from the curve.

Gms. per 100 gms. sat. sol.		Solid Phase.	Gms. per 100 gms. sat. sol.		Solid Phase.
Na_2O .	Al_2O_3 .		Na_2O .	Al_2O_3 .	
20.0	10—13	$\frac{1}{2}\text{Na}_2\text{O} \cdot 3\text{Al}_2\text{O}_3 \cdot 16\text{H}_2\text{O}$	32.0	3.2	$\frac{1}{2}\text{Na}_2\text{O} \cdot 3\text{Al}_2\text{O}_3 \cdot 16\text{H}_2\text{O}$
22.0	9.0	"	34.0	5.3	" $\frac{1}{4}\text{Na}_2\text{O} \cdot \text{Al}_2\text{O}_3 \cdot 10\text{H}_2\text{O}$
24.0	6.0	"	36.0	3.0	$\frac{1}{2}\text{Na}_2\text{O} \cdot \text{Al}_2\text{O}_3 \cdot 10\text{H}_2\text{O}$
26.0	2.5	"	38.0	1.3	"
28.0	1.0	"	40.0	0.2	"
30.0	2.5	"	40.8	0.1	" $\frac{1}{2}\text{Na}_2\text{O} \cdot 3\text{H}_2\text{O}$

The aluminium hydroxide existing as a gel may be considered as a metastable phase retaining variable quantities of alkali. There is probably a continuous transition between the hydroxide gels and the crystalline hydrate. Aluminium oxide is metastable in regard to the hydrate.

The following data for this system are given by Jucatis, 1934. The mixtures were prepared from crystalline $\text{Al}(\text{OH})_3$, pure NaOH and H_2O . They were shaken continually for some 3 months. The saturated solutions and moist residues were analyzed and the composition of the solid phase identified by plotting according to the Schreinemaker method. The original results were plotted and the following values read from the curve.

Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase
Na_2O	Al_2O_3		Na_2O	Al_2O_3	
21.3	22.0	$\text{Na}_2\text{O} \cdot \text{Al}_2\text{O}_3 \cdot 2\frac{1}{2}\text{H}_2\text{O}$	37.5	1.0	$\text{Na}_2\text{O} \cdot \text{Al}_2\text{O}_3 \cdot 2\frac{1}{2}\text{H}_2\text{O}$
21.7	16.0	"	37.7	1.4	$\frac{1}{3}\text{Na}_2\text{O} \cdot \text{Al}_2\text{O}_3 \cdot 6\text{H}_2\text{O}$
22.3	12.0	"	38.0	0.9	$3\text{Na}_2\text{O} \cdot \text{Al}_2\text{O}_3 \cdot 6\text{H}_2\text{O}$
23.5	8.0	"	39.5	0.5	"
26.7	4.0	"	40.5	0.4	"
30.0	2.2	"	42.0	0.3	"
35.0	0.9	"	43.0	0.3	"
36.5	0.7	"	44.7	1.0	"

EQUILIBRIUM IN THE SYSTEM SODIUM OXIDE, ARSENIC TRIOXIDE, WATER AT 25°.
(Schreinemakers and de Baat, 1917.)

Gms. per 100 Gms. Sat. Sol.		Solid Phase.	Gms. per 100 Gms. Sat. Sol.		Solid Phase.
As_2O_3	Na_2O		As_2O_3	Na_2O	
2.019	0	As_2O_3	31.05	21.82	$\text{Na}_4\text{As}_2\text{O}_4 \cdot 9\text{H}_2\text{O}$
14.45	2.45	"	±20	±22.7	" + $\text{Na}_{10}\text{As}_4\text{O}_{11} \cdot 26\text{H}_2\text{O}$
24.42	4.23	"	21.92	24.04	$\text{Na}_{10}\text{As}_4\text{O}_{11} \cdot 26\text{H}_2\text{O}$
37.73	6.46	"	17.50	25.64	"
58.54	9.00	"	14.26	29.16	"
±73	±12	" + NaAsO_2	14.63	30.24	"
63.01	12.73	NaAsO_2	19.32	32.04	" + $\text{Na}_4\text{As}_2\text{O}_8$
57.90	13.24	"	15.53	33.57	$\text{Na}_4\text{As}_2\text{O}_8$
48.05	14.27	"	10.49	36.21	"
36.32	18.74	"	6.59	39.39	" + $\text{NaOH} \cdot \text{H}_2\text{O}$
±34	±21.1	" + $\text{Na}_4\text{As}_2\text{O}_8 \cdot 9\text{H}_2\text{O}$	5.11	39.69	$\text{NaOH} \cdot \text{H}_2\text{O}$
32.24	21.6	$\text{Na}_4\text{As}_2\text{O}_8 \cdot 9\text{H}_2\text{O}$	0	41.2	"

SODIUM ARSENATES

EQUILIBRIUM IN THE SYSTEM SODIUM OXIDE, ARSENIC PENTOXIDE
AND WATER AT 0°.
(Rosenheim and Thon, 1927.)

Purest NaOH and As_2O_5 were used. Considerable difficulty was experienced in filtering the syrupy solutions which contained finely divided, almost colloidal particles. Filtration was accomplished by means of porcelain filter discs and suction.

Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase
As_2O_5	Na_2O		As_2O_5	Na_2O	
66.09	0.0	$\text{H}_2\text{AsO}_4 \cdot \frac{1}{2}\text{H}_2\text{O}$	38.33	10.98	$\text{NaH}_2\text{AsO}_4 \cdot \text{H}_2\text{O}$
63.03	2.17	"	39.34	12.95	"
60.14	3.11	"	39.03	13.15	"
57.26	3.77	"	35.89	13.04	"
54.15	5.36	$\text{NaH}_2\text{AsO}_4 \cdot \text{H}_2\text{O}$	30.87	10.65	$\text{Na}_2\text{HASO}_4 \cdot 12\text{H}_2\text{O}$
52.14	7.01	"	19.15	6.29	"
47.11	7.91	"	14.95	4.99	"
44.48	8.51	"	11.92	4.18	"
38.01	9.34	"	5.80	2.62	"
			3.35	1.81	"

EQUILIBRIUM IN THE SYSTEM SODIUM OXIDE, ARSENIC PENTOXIDE
AND WATER AT 20°.

(Menzel and Hagen, 1937.)

Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase
Na ₂ O	As ₂ O ₅		Na ₂ O	As ₂ O ₅	
10.70	39.70	NaH ₂ AsO ₄ · H ₂ O	9.14	13.45	□ Na ₃ AsO ₄ · 12H ₂ O
12.22	39.80	"	8.16	11.23	
13.72	40.59	"	7.73	10.24	
14.99	41.52	" + Na ₂ HAsO ₄ · 12H ₂ O	5.99	7.33	Na ₃ AsO ₄ · 12H ₂ O
(17.32	50.47)	"	4.78	3.89	
13.71	36.81	NaH ₂ AsO ₄ · 12H ₂ O	5.33	2.05	
13.03	34.07	"	7.74	0.71	
11.77	39.08	"	11.46	0.29	
11.39	26.93	"	15.08	0.15	
10.12	22.32	"	21.10	0.10	
9.09	18.31	"	25.43	0.15	
8.70	16.70	"	27.22	0.27 (tr.pt.)	
8.25	15.35	"	28.51	0.27	
9.21	16.32	"	30.25	0.31	
11.25	18.35	" + □ Na ₃ AsO ₄ · 12H ₂ O	32.12	0.44	
			35.21	0.43	lower hydrate

DISODIUM ARSENATE Na₂HAsO₄ · 12H₂O.

SOLUBILITY OF DISODIUM ARSENATE IN WATER.

(Menzel and Hagen, 1937.)

The previous results of Rosenheim and Thon, 1927, for this system are considered to be slightly in error due to inaccuracy of the analytical method.

t°	Gms. Na ₂ HAsO ₄ per 100 gms. sat. sol.	Solid Phase	t°	Gms. Na ₂ HAsO ₄ per 100 gms. sat. sol.	Solid Phase
-0.210	0.94	Ice	64	61.4	Na ₂ HAsO ₄ · 5H ₂ O
-0.615	2.67		67	63.8	"
-0.968	4.32	"	68 tr.pt.	67.3	" + Na ₂ HAsO ₄
-1.138	5.12	" + Na ₂ HAsO ₄ · 12H ₂ O	67.4	64.8	" + Na ₂ HAsO ₄ · H ₂ O
+0.1	5.59	Na ₂ HAsO ₄ · 12H ₂ O	69	64.8	Na ₂ HAsO ₄ · H ₂ O
5.0	7.93	"	75.1	64.9	"
10	11.52	"	80	65.1	"
15.0	16.92	"	85.6	65.1	"
20	25.31	"	91.7	65.4	"
20.5 tr.pt.	26.1	" + Na ₂ HAsO ₄ · 7H ₂ O	96.0	65.9	"
22.2	27.27	Na ₂ HAsO ₄ · 7H ₂ O	99.5	66.5	" + Na ₂ HAsO ₄
25	29.33	"	69.7	67.2*	Na ₂ HAsO ₄
34.9	36.73	"	81.6	66.5*	"
45.1	45.31	"	98.5	66.5*	"
50.1	49.83	"	103.1	66.7	"
56.2 tr.pt.	57.1	" + Na ₂ HAsO ₄ · 5H ₂ O	108.1	66.0	"
60.3	58.99	Na ₂ HAsO ₄ · 5H ₂ O	115.95 tr.	66.9	"

* Metastable

100 gms. sat. solution of Disodium Arsenate in 94.5 Wt. % Ethyl Alcohol contain 0.02465 gm. Na₂HAsO₄ at about 18°, Wohlk, 1934.

Tri SODIUM ARSENATE $\text{Na}_3\text{AsO}_4 \cdot 12\text{H}_2\text{O}$.

100 gms. aqueous solution contain 21.1 gms. $\text{Na}_3\text{AsO}_4 \cdot 12\text{H}_2\text{O}$ (= 10.4 gms. Na_3AsO_4) at 17°. Sp. Gr. of solution = 1.1186. (Schiff, 1860.)
 100 gms. glycerol dissolve 50 gms. sodium arsenate at 15.5°. (Ossendowski, 1907.)

SODIUM Meta BORATE $\text{Na}_2\text{B}_2\text{O}_4 \cdot 8\text{H}_2\text{O}$.SOLUBILITY OF SODIUM META BORATE IN WATER.
(Teeple, 1929.)

t°	Gms. $\text{Na}_2\text{B}_2\text{O}_4$ per 100 gms. H_2O	Solid Phase
20	25.75	$\text{Na}_2\text{B}_2\text{O}_4 \cdot 8\text{H}_2\text{O}$
35	35.7	

SODIUM Tetra BORATE (Borax) $\text{Na}_2\text{B}_4\text{O}_7 \cdot 10\text{H}_2\text{O}$.SOLUBILITY OF SODIUM TETRA BORATE IN WATER.
(Horn and Van Wagener, 1905; Sborgi, 1924; Sborgi, Bovalini and Cappellini, 1924.)

t°	Gms. $\text{Na}_2\text{B}_4\text{O}_7$ per 100 gms. H_2O	Solid Phase	t°	Gms. $\text{Na}_2\text{B}_4\text{O}_7$ per 100 gms. H_2O	Solid Phase
-0.45 Eutec.	1.10	$\text{Ice} + \text{Na}_2\text{B}_4\text{O}_7 \cdot 10\text{H}_2\text{O}$	60	19.0	$\text{Na}_2\text{B}_4\text{O}_7 \cdot 10\text{H}_2\text{O}$
0	1.11	$\text{Na}_2\text{B}_4\text{O}_7 \cdot 10\text{H}_2\text{O}$	61.5	20.5	" + $\text{Na}_2\text{B}_4\text{O}_7 \cdot 5\text{H}_2\text{O}$
10	1.60	"	65	21.9	$\text{Na}_2\text{B}_4\text{O}_7 \cdot 5\text{H}_2\text{O}$
18	2.32 (1)	"	70	24.4	"
25	3.15 (1)	"	80	31.4	"
30	3.86	"	90	41.0	"
40	6.67	"	100	52.5	"
50	10.4	"	102.9	58.9	"

BO

(1) Menzel, 1927.

SODIUM Penta BORATE $\text{Na}_2\text{B}_{10}\text{O}_{16} \cdot 10\text{H}_2\text{O}$.SOLUBILITY OF SODIUM PENTA BORATE IN WATER.
(Rollot and Peng, 1935.)

t°	Gms. $\text{Na}_2\text{B}_{10}\text{O}_{16}$ per 100 gms. sat. sol.	Solid Phase	t°	Gms. $\text{Na}_2\text{B}_{10}\text{O}_{16}$ per 100 gms. sat. sol.	Solid Phase
-0.53	1.36	Ice	85	41.9	$\text{Na}_2\text{B}_{10}\text{O}_{16} \cdot 10\text{H}_2\text{O}$
-0.91	2.68	"	90	45.5	"
-1.24	3.94	"	93	47.3	"
-1.70 Eutec.	5.8	" + $\text{Na}_2\text{B}_{10}\text{O}_{16} \cdot 10\text{H}_2\text{O}$	96	49.0	"
0	6.0	$\text{Na}_2\text{B}_{10}\text{O}_{16} \cdot 10\text{H}_2\text{O}$	99	50.9	"
13.5	8.6	"	100	51.8	" + $\text{Na}_2\text{B}_{10}\text{O}_{16} \cdot 2\text{H}_2\text{O}$
20	10.7	"	102	53.5	"
35	15.9	"	104.5	55.5	"
50	22.7	"	103	52.7	$\text{Na}_2\text{B}_{10}\text{O}_{16} \cdot 2\text{H}_2\text{O}$
59.6	27.45	"	107	54.3	"
70.8	33.7	"	108.3	54.8	"
80.0	38.8	"	109.6 b. pt.	55.3	"

* Unstable

SOLUBILITY OF SODIUM BORATES IN WATER AT 30°.
(Dukelski, 1906, complete references given)

Gms. per 100 Gms. Solution.		Gms. per 100 Gms. Residue		Solid Phase.
Na ₂ O.	B ₂ O ₃ .	Na ₂ O.	B ₂ O ₃ .	
42.0	...	...	...	NaOH.H ₂ O
41.37	5.10	43.54	4.19	"
38.85	5.55	37.20	11.18	Na ₂ O.B ₂ O ₃ .4H ₂ O
34.44	3.73	33.52	10.80	"
29.39	2.51	29.63	10.11	"
26.13	2.75	27.85	15.21	"
23.00	3.82	24.91	11.60	"
16.61	13.69	21.29	20.64	"
21.58	4.63	24.52	19.04	Na ₂ O.B ₂ O ₃ .4H ₂ O + Na ₂ O.B ₂ O ₃ .8H ₂ O
20.58	4.69	21.61	16.59	Na ₂ O.B ₂ O ₃ .8H ₂ O
15.32	6.21	19.70	17.84	"
12.39	9.12	18.05	18.17	"
8.85	10.49	11.72	20.62	Na ₂ O.B ₂ O ₃ .10H ₂ O
5.81	6.94	10.82	21.31	"
1.88	2.41	7.31	15.50	"
1.38	5.16	7.16	17.44	"
2.02	7.79	6.24	16.38	"
4.08	17.20	8.96	29.20	Na ₂ O.B ₂ O ₃ .10H ₂ O + Na ₂ O.B ₂ O ₃ .10H ₂ O
3.79	15.84	5.68	28.19	Na ₂ O.B ₂ O ₃ .10H ₂ O
2.26	12.14	5.21	29.19	"
1.99	11.84	5.74	39.66	Na ₂ O.B ₂ O ₃ .10H ₂ O + B(OH) ₃
1.86	11.18	1.06	28.78	B(OH) ₃
0.64	6.11	0.31	31.19	"
...	3.54	...	...	"

EQUILIBRIUM IN THE SYSTEM SODIUM OXIDE, BORIC OXIDE, WATER AT 60°.
(Sborgi and Mecarri, 1915, 1916)

Gms. per 100 Gms. Sat. Sol.		Solid Phase.	Gms. per 100 Gms. Sat. Sol.		Solid Phase.
Na ₂ O.	B ₂ O ₃ .		Na ₂ O.	B ₂ O ₃ .	
49.25	0	NaOH.H ₂ O	19.29	22.78	Na ₂ O.B ₂ O ₃ .4H ₂ O
48.44	0.81	"	20.30	25.50	"
49.28	1.53	" + 2Na ₂ O.B ₂ O ₃ .H ₂ O	22.21	32.17	" + Na ₂ O.B ₂ O ₃ .5H ₂ O
47.38	2.24	2Na ₂ O.B ₂ O ₃ .H ₂ O	19.43	27.00	Na ₂ O.B ₂ O ₃ .5H ₂ O
44.74	3.78	"	16.13	23.05	"
42.94	5.67	" + Na ₂ O.B ₂ O ₃ .H ₂ O	13.51	19.10	"
40.14	5.41	Na ₂ O.B ₂ O ₃ .H ₂ O	11.58	16.62	"
38.70	5.56	"	6.95	11.50	"
35.76	6.29	"	5.65	14.80	"
34.93	6.80	"	6.84	20.40	"
31.88	9.85	" (unstable)	8.42	28.05	"
29.56	11.83	"	11.29	41.47	" + Na ₂ O.B ₂ O ₃ .10H ₂ O
28.07	14.65	"	8.29	33.57	Na ₂ O.B ₂ O ₃ .10H ₂ O
33.12	7.47	" + Na ₂ O.B ₂ O ₃ .4H ₂ O	6.20	28.77	"
28.64	6.51	Na ₂ O.B ₂ O ₃ .4H ₂ O	3.22	21.94	"
22.06	10.20	"	3.40	22.59	" + H ₃ BO ₃
18.72	17.33	"	1.39	13.92	H ₃ BO ₃

SODIUM BORATES

EQUILIBRIUM IN THE SYSTEM Na_2O , B_2O_3 AND H_2O AT SEVERAL TEMPERATURES.
(Sborgi and Amelotti, 1930; Sborgi, 1932.)

The mixtures were constantly shaken for periods of 2 to 45 days.

Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase
Na ₂ O	B ₂ O ₃		Na ₂ O	B ₂ O ₃	
Results at 0°			Results at 35°		
0.0	1.49	H ₃ BO ₃	0.0	4.04	H ₃ BO ₃
0.88	4.74	" + 1.2.10	2.05	12.86	" + 1.5.10
0.34	0.76	1.2.10	3.36	16.23	1.5.10
0.46	0.65	"	4.47	18.74	" + 1.2.10
3.05	3.33	"	2.60	10.34	1.2.10
6.45	7.09	"	1.48	3.32	"
7.22	7.66	" + 1.1.8	7.43	9.75	"
8.32	4.98	1.1.8	13.04	15.40	" + 1.1.8
10.71	3.26	"	13.59	10.13	1.1.8
16.04	1.66	"	18.01	6.68	"
20.82	1.15	"	20.64	6.46	" + 1.1.4
24.12	1.67	" + 1.1.4	24.53	3.98	1.1.4
22.81	2.00*	1.1.4	33.79	3.87	"
26.66	1.50	"	37.60	5.07	"
29.43	1.21	"	40.54	5.82	" + 2.1.1
32.50	1.69	" + NaOH.4H ₂ O	41.83	5.54	2.1.1
28.33	0.45	NaOH.4H ₂ O	42.76	4.73	" + NaOH.H ₂ O
22.84	0.0	"	42.73	3.96	NaOH.H ₂ O
Results at 20°			42.48	3.09	"
			43.00	0.0	"
			Results at 45°		
0.0	2.70	H ₃ BO ₃	2.55	16.43	H ₃ BO ₃ + 1.5.10
1.50	8.70	" + 1.5.10	7.50	28.85	1.5.10 + 1.2.10
2.18	10.37	1.2.10 + "	15.32	20.10	1.1.8 + "
0.78	1.75	"	18.50	14.0	" + 1.1.4
4.60	5.26	"	37.0	5.50	1.1.1 + "
7.20	8.35	"	40.46	4.68	" + 2.1.1
8.95	10.50	" + 1.1.8	44.73	3.51	NaOH.H ₂ O + "
9.75	8.94	1.1.8			
15.78	4.40	"	Results at 90°		
19.40	2.95	"	5.86	37.46	H ₃ BO ₃ + 1.5.10
23.19	3.32	" + 1.1.4	13.0	58.0	1.2.3 + "
24.65	2.69	1.1.4	23.74	39.65	" + 1.1.4
30.71	2.31	"	30.03	16.26	1.1.1 + "
34.30	2.71	"	43.0	7.0	" + 2.1.1
39.56	3.93	NaOH.H ₂ O	57.88	1.26	NaOH + "
40.00	0.0	"			

BO

1.5.10 = $\text{Na}_2\text{O} \cdot 0.5\text{B}_2\text{O}_3 \cdot 10\text{H}_2\text{O}$; 1.2.10 = $\text{Na}_2\text{O} \cdot 0.2\text{B}_2\text{O}_3 \cdot 10\text{H}_2\text{O}$; 1.1.8 = $\text{Na}_2\text{O} \cdot \text{B}_2\text{O}_3 \cdot 8\text{H}_2\text{O}$; 1.1.4 = $\text{Na}_2\text{O} \cdot \text{B}_2\text{O}_3 \cdot 4\text{H}_2\text{O}$; 1.1.1 = $\text{Na}_2\text{O} \cdot \text{B}_2\text{O}_3 \cdot \text{H}_2\text{O}$; 2.1.1 = $2\text{Na}_2\text{O} \cdot \text{B}_2\text{O}_3 \cdot \text{H}_2\text{O}$.

Hosenheim and Loeber, 1921

The mixtures were constantly stirred for 1 to 3 days. The curve plotted from the results is somewhat irregular.

Gms. per 100 gms. sat. sol.			Gms. per 100 gms. sat. sol.		
NaOH.	H ₂ SO ₄ .	Solid Phase.	NaOH.	H ₂ SO ₄ .	Solid Phase.
0.639	5.84		0.116	1.97 (1)	Na ₂ O.2H ₂ O.10H ₂ O
1.27	9.2		0.114	8.06	"
1.62	11.2		0.149	11.14	"
1.65	9.3		8.491	11.26	"
1.23	9.20		9.180	11.07	
1.16	8.96 (1)	Na ₂ O.1H ₂ O.10H ₂ O	8.791	11.63	Na ₂ O.1H ₂ O.10H ₂ O
1.29	9.55	"	8.989	11.65	+
1.37	9.79	Na ₂ O.1H ₂ O.10H ₂ O	9.265	11.84	Na ₂ O.H ₂ O.3H ₂ O
1.69	8.78 (2)		9.845	11.15	Na ₂ O.H ₂ O.3H ₂ O
1.10	8.73		11.110	8.15	"

(1) By analysis the solid phase had the composition $\text{Na}_2\text{O} \cdot 0.4 \cdot \text{H}_2\text{O}$, $0.10 \cdot \text{H}_2\text{O}$, $0.10 \cdot \text{H}_2\text{O}$.

(7) 11 34 50 10 49 50 15 No. 11 2 34 11 30 9 7 11 11

(d) 30 30 54 24 78 92 -4

SODIUM Penta BORATE

EQUILIBRIUM IN THE SYSTEM SODIUM PENTA BOMATE
SODIUM CHLORIDE AND WATER.[illegible]

C	Ans. per 100 gms. sat. sol. Δ Solids			C	Ans. per 100 gms. sat. sol. Δ Solids		
	No. 0.68 μ	No. 1	Phase		No. 0.68 μ	No. 1	Phase
0	1.1	25.6	1.5.10 + NaCl	70	9.5	25.1	NaCl
20	10.31	0.97	1.5.10	"	7.8	23.8	"
"	8.34	2.84	"	"	12.1	2.8	1.5.10
"	6.77	6.17	"	"	11.2	0.8	"
"	6.12	7.09	"	"	10.1	8.6	" + 1.5.2
"	4.5	14.8	"	"	10.5	10.5	1.5.2
"	3.85	21.75	"	"	10.6	14.8	"
"	3.52	24.92	" + NaCl	"	10.1	18.9	"
"	1.52	25.7	NaCl	"	10.3	20.5	" + NaCl
"	0.85	26.04	"	"	10.44	22.8	NaCl
35	10.48	5.95	1.5.10	"	9.2	25.6	"
"	9.60	7.35	"	41	9.2	2.1	1.5.10 + 1.5.2
"	7.26	11.84	"	"	9.1	3.1	1.5.2
"	6.68	16.80	"	"	10.0	7.1	"
"	5.50	24.29	" + NaCl	"	10.5	13.4	"
"	4.07	25.02	NaCl	"	10.12	19.1	" + NaCl
"	1.65	26.89	"	"	11.7	21.6	NaCl
"	0.98	26.18	"	"	8.6	25.6	"
70	25.7	6.2	1.5.10	100	9.1	1.5	1.5.2
"	24.3	7.25	"	"	9.1	0.2	"
"	22.7	9.1	"	"	10.1	8.26	"
"	21.6	11.1	"	"	10.1	11.50	"
"	20.2	12.7	"	"	10.4	11.1	"
"	19.2	14.8	" + 1.5.2	"	10.1	15.1	"
"	15.6	17.5	1.5.2	"	10.9	16.15	"
"	14.8	18.2	"	"	10.3	17.3	" + NaCl
"	13.3	20.4	"	"	10.4	20.6	NaCl
"	11.6	21.9	" + NaCl	"	9.1	25.0	"

$$1.5.10 = \text{Na}_2\text{O} \cdot 5\text{B}_2\text{O}_3 \cdot 10\text{H}_2\text{O}; \quad 1.5.11 = \text{Na}_2\text{O} \cdot 4\text{B}_2\text{O}_3 \cdot 2\text{H}_2\text{O}.$$

SOLUBILITY IN WATER OF SODIUM META BORATE AND OF SODIUM TETRA BORATE, EACH SEPARATELY, IN PRESENCE OF SODIUM CHLORIDE AND OF SODIUM CARBONATE AT 35°.

(Teeple, 1929.)

Gms. per 100 gms. H ₂ O					Solid Phase
Na ₂ B ₂ O ₄	Na ₂ B ₄ O ₇	NaCl	Na ₂ CO ₃	NaHCO ₃	
8.3	—	33.5	—	—	D.S. + NaCl
34.0	—	—	33.0	—	1.1.8 + Na ₂ CO ₃ ·H ₂ O
32.8	—	13.7	—	—	" + D.S.
6.8	—	23.2	32.8	—	D.S. + NaCl + Na ₂ CO ₃ ·H ₂ O
26.9	—	6.9	26.2	—	" + 1.1.8 + "
—	2.2	35.2	—	—	NaCl + 1.2.10
—	4.6	—	—	12.6	NaHCO ₃ + "
—	2.5	34.8	—	2.1	" + " + NaCl

1.1.8 = Na₂O·B₂O₃·8H₂O; 1.2.10 = Na₂O·2B₂O₃·10H₂O; D.S. = Na₂O·B₂O₃·2NaCl·4H₂O.

SOLUBILITY IN WATER OF MIXTURES OF SODIUM META BORATE, SODIUM TETRA BORATE AND SODIUM CHLORIDE.

(Teeple, 1929.)

Results at 20°

Results at 35°

Gms. per 100 gms. H ₂ O			Solid Phase	Gms. per 100 gms. H ₂ O			Solid Phase
Na ₂ B ₂ O ₄	Na ₂ B ₄ O ₇	NaCl		Na ₂ B ₂ O ₄	Na ₂ B ₄ O ₇	NaCl	
—	2.5	—	1.2.10	—	5.3	—	1.2.10
0.5	1.95	—	"	35.7	—	—	1.1.8
4.9	0.5	—	"	—	2.2	35.5	NaCl + 1.2.10
11.3	0.4	—	"	8.3	—	33.5	" + D.S.
25.75	—	—	1.1.8	34.8	5.6	—	1.1.8 + 1.2.10
25.1	0.5	—	" + 1.2.10	32.8	—	13.7	" + D.S.
23.0	—	19.2	D.S. + NaCl	8.0	2.0	33.1	NaCl + " + 1.2.10
8.0	—	33.3	" + "	32.7	5.2	12.9	1.1.8 + " + "
—	0.9	36.0	1.2.10 + "				
0.5	0.5	35.8	" + "				
2.3	0.3	34.7	" + "				
23.2	0.4	19.3	" + 1.1.8 + D.S.				
8.0	0.2	33.2	" + NaCl + "				

SOLUBILITY IN WATER OF MIXTURES OF SODIUM META BORATE, TRI SODIUM PHOSPHATE AND SODIUM CHLORIDE AT 20°.

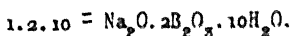
(Teeple, 1929.)

Gms. per 100 gms. H ₂ O			Solid Phase
Na ₂ B ₂ O ₄	Na ₃ PO ₄	NaCl	
1.17	11.2	—	Na ₃ PO ₄ ·12H ₂ O + Na ₂ O·B ₂ O ₃ ·2Na ₃ PO ₄ ·36H ₂ O
0.2	2.9	—	Na ₂ O·B ₂ O ₃ ·2Na ₃ PO ₄ ·36H ₂ O
25.5	0.03	—	" + 1.1.8
23.0	—	19.2	Na ₂ O·B ₂ O ₃ ·2NaCl·4H ₂ O + "
8.0	—	33.0	" + NaCl
—	1.9	35.0	Na ₃ PO ₄ ·12H ₂ O + "
23.0	0.2	19.2	1.1.8 + Na ₂ O·B ₂ O ₃ ·2NaCl·4H ₂ O + Na ₂ O·B ₂ O ₃ ·2Na ₃ PO ₄ ·36H ₂ O
8.0	0.15	33.0	" + "
0.6	1.5	35.0	NaCl + "
0.4	2.0	35.0	Na ₃ PO ₄ ·12H ₂ O + "

SOLUBILITY IN WATER OF MIXTURES OF SODIUM TETRA BORATE,
DI SODIUM PHOSPHATE AND SODIUM CHLORIDE AT 20°.

(Teeple, 1929.)

Gms. per 100 gms. H ₂ O			Solid Phase
Na ₂ B ₄ O ₇	Na ₂ HPO ₄	NaCl	
2.0	2.6	—	1.2.10
1.5	6.7	—	" + Na ₂ HPO ₄ · 12H ₂ O
—	7.0	33.8	NaCl + "
0.85	—	36.5	" + 1.2.10
0.8	0.7	35.7	" + "
0.8	2.7	34.8	" + "
1.0	7.2	33.3	" + "
1.0	7.8	32.5	" + " + Na ₂ HPO ₄ · 12H ₂ O.



EQUILIBRIUM IN THE SYSTEM SODIUM TETRABORATE, SODIUM SULFATE AND WATER
AT VARIOUS TEMPERATURES.

(Sborgi, Rovalini and Cappellini, 1934.)

Constant agitation in a thermostat was employed for securing equilibrium.

BO

t°.	Gms. per 100 gms. sat. sol.		Solid Phase.	t°.	Gms. per 100 gms. sat. sol.		Solid Phase.
	Na ₂ B ₄ O ₇	Na ₂ SO ₄			Na ₂ B ₄ O ₇	Na ₂ SO ₄	
- 0.45	1.086	0.0	Na ₂ B ₄ O ₇ · 10H ₂ O + Ice	30.0	0.0	28.6	Na ₂ SO ₄ · 10H ₂ O
- 1.38	0.631	3.82	" + Na ₂ SO ₄ · 10H ₂ O + Ice	31.9	1.41	32.38	" + Na ₂ SO ₄ + Na ₂ B ₄ O ₇ · 10H ₂ O
- 1.2	0.0	3.85	Na ₂ SO ₄ · 10H ₂ O + Ice	35.0	4.829	0.0	Na ₂ B ₄ O ₇ · 10H ₂ O
+ 10.0	1.603	0.0	Na ₂ B ₄ O ₇ · 10H ₂ O	35.0	3.405	3.665	"
10.0	1.086	1.843	"	35.0	1.798	24.18	"
10.0	0.806	4.383	"	35.0	1.73	26.95	"
10.0	0.704	8.36	" + Na ₂ SO ₄ · 10H ₂ O	35.0	1.603	31.64	"
10.0	0.0	8.43	Na ₂ SO ₄ · 10H ₂ O	35.0	1.579	32.25	" + Na ₂ SO ₄
20.0	2.52	0.0	Na ₂ B ₄ O ₇ · 10H ₂ O	35.0	1.263	32.60	Na ₂ SO ₄
20.0	1.108	9.238	"	35.0	0.554	32.91	"
20.0	1.00	16.11	" + Na ₂ SO ₄ · 10H ₂ O	35.0	0.00	33.07	"
20.0	0.0	16.23	Na ₂ SO ₄ · 10H ₂ O	45.0	7.49	0.00	Na ₂ B ₄ O ₇ · 10H ₂ O
25.0	3.087	0.0	Na ₂ B ₄ O ₇ · 10H ₂ O	45.0	6.361	4.258	"
25.0	2.626	1.187	"	45.0	4.112	13.992	"
25.0	2.057	3.22	"	45.0	3.124	30.15	" + Na ₂ SO ₄
25.0	1.442	9.645	"	45.0	1.145	31.273	Na ₂ SO ₄
25.0	1.300	12.66	"	45.0	0.600	41.649	"
25.0	1.248	15.57	"	49.3	4.584	29.245	" + Na ₂ B ₄ O ₇ · 10H ₂ O
25.0	1.229	16.76	"				+ Na ₂ B ₄ O ₇ · 5H ₂ O
25.0	1.220	17.38	"	50.0	9.52	0.0	Na ₂ B ₄ O ₇ · 10H ₂ O
25.0	1.131	21.926	" + Na ₂ SO ₄ · 10H ₂ O	50.0	6.936	7.978	"
25.0	0.326	21.91	Na ₂ SO ₄ · 10H ₂ O	50.0	5.116	21.171	"
25.0	0.0	21.90	"	50.0	4.760	25.482	"
30.0	3.75	0.0	Na ₂ B ₄ O ₇ · 10H ₂ O	50.0	4.61	29.00	" + Na ₂ SO ₄
30.0	1.27	28.78	" + Na ₂ SO ₄ · 10H ₂ O	50.0	1.872	30.62	Na ₂ SO ₄
				50.0	0.92	31.09	"
				50.0	0.0	31.9	"

EQUILIBRIUM IN THE SYSTEM SODIUM TETRABORATE,
SODIUM SULFATE AND WATER (CON.).

t°	Gms. per 100 gms. sat. sol.		Solid Phase.	t°	Gms. per 100 gms. sat. sol.		Solid Phase.
	Na ₂ B ₄ O ₇	Na ₂ SO ₄			Na ₂ B ₄ O ₇	Na ₂ SO ₄	
55.0..	12.37	0.0	Na ₂ B ₄ O ₇ ·10H ₂ O	65.0....	17.953	0.0	Na ₂ B ₄ O ₇ ·5H ₂ O
55.0..	8.473	13.05	"	65.0....	16.10	3.71	"
55.0..	8.06	16.97	»+Na ₂ B ₄ O ₇ ·5H ₂ O	65.0....	15.98	3.94	"
55.0..	7.884	17.646	Na ₂ B ₄ O ₇ ·5H ₂ O	65.0....	10.46	17.08	"
55.0..	7.58	18.31	"	65.0....	7.90	26.47	»+Na ₂ SO ₄
55.0..	7.68	20.97	"	65.0....	2.86	29.37	Na ₂ SO ₄
55.0..	7.44	21.21	"	80.0....	23.9	0.0	Na ₂ B ₄ O ₇ ·5H ₂ O
55.0..	6.49	26.23	"	80.0....	14.57	22.38	»+Na ₂ SO ₄
55.0..	5.99	28.08	»+Na ₂ SO ₄	102.9 b. pt.	37.07	0.0	Na ₂ B ₄ O ₇ ·5H ₂ O
55.0..	0.0	31.575	Na ₂ SO ₄	104.	28.15	15.89	»+Na ₂ SO ₄

In addition to the above results Sborgi and his associates give all other necessary data for constructing the space diagram of the system Na₂B₄O₇ + (NH₄)₂SO₄ ⇌ (NH₄)₂B₄O₇ + Na₂SO₄.

100 gms. 86.5% glycerol (*d* = 1.2326 dissolve 89.0 gms. Na₂B₄O₇·10H₂O at 20°.
" 98.5% " (*d* = 1.2645 " 111.0 " " " (Holm, 1921, 1921 a, 1922.

SOLUBILITY OF SODIUM BORATES IN SEVERAL SOLVENTS.

Borate.	Solvent.	t°	Gms. Salt per 100 Gms. Solvent.	Authority.
Sodium borate	Alcohol (<i>d</i> = 0.941)	15.5	2.48	(U. S. P. VIII.)
" "	Glycerol	15.5	60.3	(U. S. P. VIII.)
" "	"	80	100	(U. S. P. VIII.)
Sodium Biborate	Trichlorethylene	15	0.011	(Wester and Bruins, 1914.)

Fusion-point data for mixtures of NaBO₂+NaPO₃ and NaBO₂+Na₂SiO₃ are given by Van Klooster (1910-11). Results for Na₂B₄O₇+Na₄P₂O₇ are given by Le Chatelier (1894).

SODIUM BROMIDE NaBr·2H₂O.

SOLUBILITY OF SODIUM BROMIDE IN WATER.

Br

The results of Rüdorff, 1862; Guthrie, 1875; de Coppet, 1883; Richards and Churchill, 1899; Etard, 1894; Cocheret, 1911; Greenish, 1900; Scott and Frazier, 1927; Scott and Durham, 1930; Nikolaew and Rawitch, 1931; and Ricci, 1934, were plotted and the following values taken from the average curve.

t°	Gms. NaBr per 100 gms. sat. sol.	Solid Phase	t°	Gms. NaBr per 100 gms. sat. sol.	Solid Phase
-5	12.5	Ice	30	49.6	NaBr·2H ₂ O
-10	21.0	"	35	50.48 (1.5655)	"
-15	27.5	"	45.21	52.66 (1.5950)	"
-20	33.0	"	50.21	53.80 (1.6108)	"
-25	37.7	"	51.0	53.9	" + NaBr
-28	40.3	" + NaBr·2H ₂ O	60.17	54.10 (1.6073)	NaBr
-20	41.8	NaBr·2H ₂ O	75.44	54.41 (1.5986)	"
-10	42.9	"	91.95	54.83 (1.5915)	"
0	44.47 (1.4954)	"	100	53.8-54.8	"
+10	46.0	"	140	55.5-56.5	"
16.4	47.0 (1.523)	"	180	57.4-59.5	"
20	47.6	"	210	58.8-60.9	"
25	48.61 (1.5418)	"	230	59.8-62.0	"
			250	61.0- —	"

The figures in parentheses

SOLUBILITY OF SODIUM BROMIDE IN AQUEOUS SOLUTIONS OF
HYDROBROMIC ACID AT 25°.

(Scott and Durham, 1930.)

Gms. per 100 gms. sat. sol.	
HBr	NaBr
0.0	48.22
4.61	42.55
9.04	37.19
12.98	33.62
17.65	27.31

SOLUBILITY OF SODIUM BROMIDE IN AQUEOUS SOLUTIONS OF
HYDROBROMIC ACID AT SEVERAL TEMPERATURES.

(Nikolaew and Sawitch, 1931.)

d. of sat. sol.	Gms. per 100 gms. sat. sol.		Solid Phase	d. of sat. sol.	Gms. per 100 gms. sat. sol.		Solid Phase
	HBr	NaBr			HBr	NaBr	

Results at 25°

1.5426	0.0	48.56
1.5245	3.03	44.97
1.4989	8.84	38.20
1.4789	14.22	31.68
1.4642	18.69	27.24
1.4534	23.10	22.21
1.4468	28.77	16.38
1.4484	33.16	12.84
—	37.21	9.81
—	41.38	6.33
1.4825	43.41	4.62
1.5260	49.25	1.59
1.6171	55.78	0.40

NaBr. 2H ₂ O	1.4912
"	1.4782
"	1.5560
"	1.5455
"	1.5361
"	1.5121
"	1.4961
"	1.4850
"	1.4596
"	1.4689
"	1.4689

Results at 44.5°

0.0	52.56	NaBr. 2H ₂ O
3.94	47.87	"
10.21	40.76	"
11.49	39.51	NaBr
12.76	37.62	"
17.89	31.36	"
21.91	26.74	"

Results at 65°

4.04	47.67	NaBr
13.30	33.80	"
18.29	27.50	"
23.51	22.37	"

SOLUBILITY OF SODIUM BROMIDE IN AQUEOUS SOLUTIONS OF SODIUM
HYDROXIDE AT SEVERAL TEMPERATURES.

(Nikolaew and Sawitch, 1931.)

d. of sat. sol.	Gms. per 100 gms. sat. sol.		Solid Phase	d. of sat. sol.	Gms. per 100 gms. sat. sol.		Solid Phase
	Na ₂ O	NaBr			Na ₂ O	NaBr	

Results at 25°

1.5421	0.87	47.22	NaBr. 2H ₂ O
1.5404	2.50	44.51	"
1.5402	4.41	41.94	"
1.5502	8.96	36.73	"
1.5634	11.37	34.61	"
—	12.32	33.47	NaBr
—	14.56	29.89	"
1.5535	19.78	23.42	"
1.5611	24.66	18.71	"
1.5770	27.87	16.10	"
1.6112	32.31	13.35	"

Results at 44.5°

1.4955	1.71	50.21	NaBr. 2H ₂ O
1.4958	1.98	47.20	" + NaBr
1.4845	6.40	43.22	NaBr
1.5615	13.35	33.94	"
—	16.68	28.32	"

Results at 65°

4.04	47.67	NaBr
13.30	33.80	"
18.29	27.50	"
23.51	22.37	"

The authors also give f. pt. determinations of mixtures of NaBr + HBr and of NaBr + NaOH. The existence of NaBr. 2H₂O is shown.

SOLUBILITY OF SODIUM BROMIDE IN AQUEOUS SOLUTIONS OF SODIUM HYDROXIDE AT 17°.
(Ditte, 1897.)

Gms. per 100 Gms. H ₂ O.		Gms. per 100 Gms. H ₂ O.		Gms. per 100 Gms. H ₂ O.	
NaOH.	NaBr.	NaOH.	NaBr.	NaOH.	NaBr.
0.0	91.38	17.17	63.06	28.43	48.00
3.26	79.86	19.12	62.51	36.61	38.41
9.24	68.85	22.35	59.60	46.96	29.37
13.43	64.90	24.74	55.03	54.52	24.76

EQUILIBRIUM IN THE SYSTEM SODIUM BROMIDE, SODIUM BROMATE AND WATER.
(Ricci, 1934.)

d. of sat. sol.	Gms. per 100 gms. sat. sol.		Solid Phase	d. of sat. sol.	Gms. per 100 gms. sat. sol.		Solid Phase
	NaBr	NaBrO ₃			NaBr	NaBrO ₃	

Results at 10°				Results at 25° (Con.)			
1.492	45.80	0.0	NaBr. 2H ₂ O	1.457	38.66	4.78	NaBrO ₃
1.517	44.51	2.58	" + NaBrO ₃	1.377	29.83	7.86	"
1.498	43.09	2.83	NaBrO ₃	1.320	21.27	12.04	"
1.452	39.40	3.55	"	1.282	13.82	16.72	"
1.240	11.10	14.46	"	1.270	6.46	22.38	"
1.220	5.33	18.73	"	1.257	0.0	28.29	"
1.211	0.0	23.24	"				

Results at 25°				Results at 45°			
1.530	48.41	0.0	NaBr. 2H ₂ O	—	52.55	0.0	NaBr. 2H ₂ O
1.546	47.37	1.90	"	—	50.68	3.51	" + NaBrO ₃
1.555	46.82	2.94	" + NaBrO ₃	—	44.39	3.72	NaBrO ₃
1.542	45.62	3.15	NaBrO ₃	—	28.69	11.17	"
1.462	39.24	4.61	"	—	7.91	26.65	"

EQUILIBRIUM IN THE SYSTEM SODIUM BROMIDE, SODIUM CHLORIDE AND WATER AT 8°-10°.
(Rakowski and Polanski, 1977.)

Gm. Mols. per 100 gms. sat. sol.		Gm. Mols. per 100 gms. sat. sol.		Gm. Mols. per 100 gms. sat. sol.		Gm. Mols. per 100 gms. sat. sol.	
NaCl	NaBr	NaCl	NaBr	NaCl	NaBr	NaCl	NaBr
0.0	12.80	2.53	10.26	2.74	11.18	5.45	6.15
1.02	12.02	2.62	10.34	3.30	10.08	5.89	5.75
1.34	11.70	2.65	10.36	3.59	9.53	6.49	4.62
1.73	11.45	2.94	9.93	3.83	8.97	6.93	3.99
2.14	10.94	3.05	9.90	4.27	8.30	7.17	3.68
2.24	10.87	3.38	9.49	4.70	7.88	8.63	1.70
2.54	10.47	3.61	9.39	4.87	7.05	9.91	0.0

Na NATRIUM SODIUM BROMIDE

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EQUILIBRIUM IN THE SYSTEM SODIUM BROMIDE, SODIUM IODATE AND WATER.

(Ricci, 1934.)

d. of sat. sol.	Gms. per 100		Solid Phase
	gas. sat. sol.		
	NaBr	NaIO ₃	
Results at 5°			
1.489	45.08	0.0	NaBr.2H ₂ O
1.492	45.04	0.075	" + D.S. 15
1.473	43.99	0.084	D.S. 15
1.415	39.98	0.124	"
1.287	29.50	0.584	"
1.238	24.56	1.09	"
1.230	23.51	1.28	" + NaIO ₃ .5H ₂ O
1.225	22.95	1.25	NaIO ₃ .5H ₂ O
1.132	14.13	1.09	"
1.052	4.97	1.44	"
1.027	0.0	3.297	"
1.227	23.30	1.34	D.S. 15
1.215	21.71	1.78	" + NaIO ₃ .5H ₂ O
1.204	20.78	1.74	NaIO ₃ .5H ₂ O
1.123	12.26	2.03	"
1.079	6.97	2.52	"
1.050	0.0	5.479	"
Results at 25°			
1.530	48.41	0.00	NaBr.2H ₂ O
1.537	48.21	0.42	" + D.S. 15
1.509	46.73	0.45	D.S. 15
1.417	39.55	0.86	"
1.367	35.23	1.51	"
1.343	32.68	2.16	" + NaIO ₃ .H ₂ O
1.266	26.39	2.35	NaIO ₃ .H ₂ O
1.172	16.40	3.00	"
1.104	7.78	4.46	"
1.075	0.0	8.569	"

Gms. per 100	sol.	Solid Phase		
			gas. sat. sol.	
			NaBr	NaIO ₃
Results at 40°				
51.55	0.0	NaBr.2H ₂ O		
50.84	1.37	" + D.S. 10		
49.38	1.53	D.S. 10		
47.95	1.77	" + D.S. 15		
46.82	1.89	D.S. 15		
44.86	2.13	"		
43.77	2.48	"		
41.96	2.69	" + NaIO ₃		
42.44	2.52	NaIO ₃		
40.05	2.63	"		
39.5	2.65	" + NaIO ₃ .H ₂ O		
37.29	2.80	NaIO ₃		
36.06	2.68	NaIO ₃ .H ₂ O		
32.08	2.77	"		
20.65	1.65	"		
0.0	11.70	"		
Results at 60°				
53.63	0.0	NaBr.2H ₂ O		
53.0	1.57	" + NaBr		
52.57	2.37	" + D.S. 10		
51.40	2.49	D.S. 10		
50.93	2.63	" + NaIO ₃		
44.74	2.50	NaIO ₃		
32.41	3.41	"		
21.46	5.15	" + NaIO ₃ .H ₂ O		
13.28	6.38	NaIO ₃ .H ₂ O		
6.63	9.03	"		
0.0	13.49	"		

Br

* = Metastable

D.S. 15 = $\frac{1}{3}$ NaBr.2NaIO₃.15H₂O; D.S. 10 = $\frac{1}{3}$ NaBr.2NaIO₃.10H₂O.

Similar results are also given for the 15°, 35°, and 45° isotherms.

EQUILIBRIUM IN THE SYSTEM SODIUM BROMIDE, SODIUM NITRATE AND WATER AT 25°.

(Ricci, Budnik and Borodulin, 1937.)

Gms. per 100 NaNO ₃	Gms. sat. sol.		Solid Phase	Gms. per 100 NaNO ₃	Gms. sat. sol.		Solid Phase
	NaNO ₃	NaBr			NaNO ₃	NaBr	
0.0	48.41		NaBr.2H ₂ O	15.72	37.11		NaNO ₃
8.41	44.08		"	19.80	31.94		"
11.36	42.26		"	25.14	24.63		"
13.62	41.05		" + NaNO ₃	31.67	17.02		"
14.42	39.74		NaNO ₃	47.87	0.0		"

SOLUBILITY OF SODIUM BROMIDE IN AQUEOUS ETHYL ALCOHOL AT 30°.
(Cocheret, 1911.)

Gms. per 100	Gms. Sat. Sol.	Solid Phase.	Gms. per 100	Gms. Sat. Sol.	Solid Phase.
C_2H_5OH .	NaBr.		C_2H_5OH .	NaBr.	
0	40.4	NaBr.2H ₂ O	65.51	16.08	NaBr.2H ₂ O
11.79	42.9	"	72.36	13.41	"
31.78	32.12	"	76.92	12.03	" + NaBr
43.22	26.79	"	87.35	7.44	NaBr
54.59	20.83	"	97.08	3.01	"

SOLUBILITY OF SODIUM BROMIDE IN AQUEOUS ETHYL ALCOHOL AT 25°.
(Flatt and Jordan, 1933.)

Wt. % C_2H_5OH in solvent	Gms. NaBr per 100:			Solid Phase
	gms. solvent	gms. sat. sol.	cc. sat. sol.	
0.0	93.55	48.32	93.45	NaBr.2H ₂ O
20.4	77.26	43.59	75.21	"
42.5	57.43	36.48	54.18	"
67.9	33.75	25.24	29.95	"

SOLUBILITY OF SODIUM BROMIDE IN 95% ETHYL ALCOHOL SOLUTIONS
OF HYDROBROMIC ACID AT 25°.

(Yagoda, 1930.)

Normality of HBr in 95% C_2H_5OH	d. of solvent	Gms. NaBr per 100 gms. solvent	Normality of HBr in 95% C_2H_5OH	d. of solvent	Gms. NaBr per 100 gms. solvent
0.0	0.7997	3.97	0.337	0.833	4.48
0.100	0.810	4.04	0.629	0.862	4.50
0.162	0.815	4.35	0.800	0.878	4.35
0.204	0.820	4.25	0.954	0.893	4.55

SOLUBILITY OF SODIUM BROMIDE IN PURE METHYL ALCOHOL.

(Brown, Glynwyn, Bonnel and Jones, 1928.)

t°	Gms. NaBr per 100 gms. CH_3OH	t°	Gms. NaBr per 100 gms. CH_3OH	t°	Gms. NaBr per 100 gms. CH_3OH
0	17.3	20	16.8	50	15.8
10	17.0	30	16.5	16	15.3
15	16.9	40	16.1		

SOLUBILITY OF SODIUM BROMIDE IN ABSOLUTE ETHYL ALCOHOL.

(Bonnell and Jones, 1926.)

The materials were carefully purified and especial attention paid to removal of traces of water from the alcohol. The mixtures were kept in a thermostat and shaken by hand at intervals during a long period. In some cases saturation was approached from above.

t°.	Gms. NaBr per 100 gms. C_2H_5OH .	t°.	Gms. NaBr per 100 gms. C_2H_5OH .	t°.	Gms. NaBr per 100 gms. C_2H_5OH .
0.0.....	2.445	20.0.....	2.322	50.0.....	2.259
10.0.....	2.379	25.0.....	2.314	60.0.....	2.312
15.0.....	2.343	30.0.....	2.292	70.0.....	2.345
		40.0.....	2.276		

SOLUBILITY OF SODIUM BROMIDE IN ALCOHOLIC SOLUTIONS.
(Rohland, 1898-05; de Bruyn, 1891; Eder, 1876.)

Alcohol.	Concentration of Aq. Alcohol.	t°.	Gms. NaBr per 100 Gms. Alcohol.	
Methyl Alcohol	$d_{15}=0.799$	room temp.	21.7	(R.)
Ethyl "	$d_{15}=0.810$	"	7.14	"
Propyl "	$d_{15}=0.816$	"	2.01	"
Ethyl "	90% by vol.	?	4.0 (hydrated NaBr)	
Methyl "	Absolute	19.5	17.35 (de Bruyn)	
Ethyl "	"	15	6.3 (NaBrH ₂ O) (Eder.)	
Ethyl Ether	"	15	0.08	"

A sat. solution of NaBr in CH₃OH contains 0.9 gm. NaBr per 100 gms. solution at the critical temperature.

100 cc. of ethyl alcohol of $d = 0.8327$ dissolve 7.37 gms. NaBr at 16.4°, d_{16} of sat. sol. = 0.889. (Centnerzwer, 1910)

100 gms. propyl alcohol dissolve 2.05 gms. NaBr at ord. temp. (Greenish, 1900)

(Schlamp, 1894)

SOLUBILITY OF SODIUM BROMIDE IN MIXTURES OF ALCOHOLS AT 25°.
(Herz and Kuhn, 1908)

Br	In CH ₃ OH + C ₂ H ₅ OH.			In CH ₃ OH + C ₃ H ₇ OH.			In C ₂ H ₅ OH + C ₃ H ₇ OH.		
	Per cent CH ₃ OH in Mixture.	d_{25} of Sat. Sol.	Gms. NaBr per 100 cc. Sat. Sol.	Per cent C ₂ H ₅ OH in Mixture.	d_{25} of Sat. Sol.	Gms. NaBr per 100 cc. Sat. Sol.	Per cent C ₂ H ₅ OH in Mixture.	d_{25} of Sat. Sol.	Gms. NaBr per 100 cc. Sat. Sol.
	0	0.8189	2.03	0	0.9238	14.40	0	0.8180	2.03
	4.37	0.8265	3.65	11.11	0.9048	12.43	8.1	0.8147	2.49
	10.4	0.8273	4.04	23.8	0.8887	10.53	17.85	0.8145	2.47
	41.02	0.8593	7.24	65.2	0.8490	4.42	86.6	0.8107	1.00
	80.60	0.9079	12.51	91.8	0.8153	1.47	88.6	0.8116	1.11
	84.77	0.9104	12.86	93.75	0.8144	1.26	91.2	0.8083	0.83
	91.25	0.9235	14.32	100	0.8093	0.74	95.2	0.8090	0.82
	100	0.9238	14.40				100	0.8093	0.74

SOLUBILITY OF SODIUM BROMIDE IN ACETAMIDE AT VARIOUS TEMPERATURES.
(Menschutkin, 1908)

t°.	Gms. per 100 Gms. Sat. Sol.		Solid Phase.	t°.	Gms. per 100 Gms. Sat. Sol.		Solid Phase.
	NaBr.2(CH ₃ - CONH ₂	= NaBr.			NaBr.2(CH ₃ - CONH ₂	= NaBr.	
82*	...	...	CH ₃ CONH ₂	90	39.4	13.7	NaBr.2CH ₃ CONH ₂
80	6	2.8	"	100	32.2	15	"
78	11.5	5.36	"	110	35.3	16.4	"
76	16.3	7.6	"	120	38.7	18	"
74	20.2	9.4	"	130	42.6	19.8	"
72	23	10.7	"	135†	45.3	21.1	" + NaBr
70‡	25	11.6	" + NaBr.2CH ₃ CONH ₂	155	46.4	21.6	NaBr
80	27	12.6	NaBr.2CH ₃ CONH ₂	175	47.5	22.1	"

* M. pt.

† Tr. pt.

‡ Eutec.

100 gms. 95% formic acid dissolve 22.3 gms. NaBr at 18.5°. (Aschan, 1911)

100 cc. anhydrous hydrazine dissolve 37 gms. NaBr at room temp.

(Welsh and Lindstrom, 1915)

100 gms. 86.5% glycerol ($d = 1.246$) dissolve 44.7 gms. NaBr at 20°.

" 98.5 " ($d = 1.2645$) " 38.2 " "

100 cc. sat. solution of sodium bromide in ethyl urethan contain 5.081 gms. NaBr at 60°. (Holm, 1921, 1922)

(Stuckgold, 1911)

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SOLUBILITY OF SODIUM BROMIDE IN ACETONE.

NATRIUM Na

t°	Gms. NaBr per liter sat. solution	Authority
18	0.095	(Lannung, 1932.)
25	0.079	(Kraus and Seward, 1927.)
25	0.122	(Swearingen and Florence, 1935.)
25	0.63(?)	(Koch, 1930a.)
37	0.075	(Lannung, 1932.)

The results of Lannung were calculated from specific conductivity measurements in solutions prepared with highly purified acetone.

SOLUBILITY OF SODIUM BROMIDE IN ACETONE SOLUTIONS OF
LITHIUM PERCHLORATE AND OF CALCIUM PERCHLORATE AT 25°.
(Swearingen and Florence, 1935.)

Results for acetone' solutions of:

Lithium Perchlorate		Calcium Perchlorate	
Gm. Mols. per liter sat. sol. LiClO ₄	NaBr	Gm. Mols. per liter sat. sol. LiClO ₄	NaBr
0.0000	0.00190	0.003591	0.002246
0.000310	0.001779	0.0019239	0.003575
0.000547	0.001452	0.038147	0.005207
0.000785	0.001582	0.078221	0.008243
0.001974	0.001926	0.392690	0.021575
			0.004129
			0.008421
			0.009477

SOLUBILITY OF SODIUM BROMIDE IN ACETONE SOLUTIONS OF
SODIUM NITRATE AT 25°.
(Kraus and Seward, 1927, 1928.)

Gm. Mols. per liter sat. solution	
NaNO ₃	NaBr
0.0000	0.000768
0.000137	0.000760
0.000229	0.000746
0.000660	0.000713

SOLUBILITY OF SODIUM BROMIDE IN WATER AND IN SEVERAL ALCOHOLS AT 25°.
(Larson and Hunt, 1939.)

Solvent	Formula	d. of sat. solution	Gms. NaBr per 100 gms. solvent
Water	H ₂ O	—	93.50
Methanol	CH ₃ OH	0.9073	17.36
Ethanol	C ₂ H ₅ OH	0.8019	2.406
1-Propanol	CH ₃ CH ₂ CH ₂ OH	0.8026	0.4562
1-Butanol (n)	CH ₃ (CH ₂) ₂ CH ₂ OH	0.8075	0.246
2-Propanol (iso)	CH ₃ CHOHCH ₃	0.7818	0.1313
2-Methyl-1-Propanol	(CH ₃) ₂ CHCH ₂ OH	0.7986	0.0951
1-Pentanol	CH ₃ (CH ₂) ₃ CH ₂ OH	0.8106	0.1103
2 Butanol (sec.)	CH ₃ CH ₂ CHOHCH ₃	0.8025	0.0341

SODIUM BROMIDE

EQUILIBRIUM IN THE SYSTEM SODIUM BROMIDE, ISO PROPYL
ALCOHOL AND WATER AT 25°.
(Ginnings and Chen, 1931.)

Points on the binodal curve of the system were determined by the titration method and a tie line, \cdot , located by estimation of the NaBr in layers in contact with each other. The plait point, PP, was found by plotting.

Gms. per 100 gms. sat. sol.		Gms. per 100 gms. sat. sol.	
iso C_3H_7OH	NaBr \cdot	iso C_3H_7OH	NaBr \cdot
62.10	11.40 \cdot	30.40	27.20
53.10	11.70	8.70	15.0
41.50	18.00	6.10	42.60 \cdot
29.5	21.6 PP.		

The composition of the homogeneous mixture (plait point) at 25° of the system NaBr + Tertiary Butyl Alcohol + H_2O was found by Ginnings, Herring and Webb, 1933 to be

11.0 percent NaBr + 36.1 percent ter. $(CH_3)_3COH$ + 52.7 percent H_2O .

The original results for the remaining points on the binodal curve are not given but only the values corresponding to derived empirical equations for the curve.

Br

SOLUBILITY OF SODIUM BROMIDE IN ISO AMYL ALCOHOL SOLUTIONS
OF HYDROBROMIC ACID AT 25°.
(Fagola, 1926.)

Normality of HBr in iso $C_5H_{11}OH$	d. of solvent	Gms. NaBr per 100 cc. solvent	Normality of HBr in iso $C_5H_{11}OH$	d. of solvent	Gms. NaBr per 100 cc. solvent
0.0	0.805	0.085	0.464	0.840	0.274
0.066	0.8166	0.124	0.764	0.8754	0.190
0.181	0.8262	0.174			

SOLUBILITY OF SODIUM BROMIDE IN LIQUID AMMONIA.

The results of Scherer, 1911; Hunt, 1911; Johnson and Krumholz, 1933; Linhard and Stephan, 1933, 1934; Distanow, 1937 and Portnow and Rawdine, 1937, were calculated to a common basis, plotted, and the following values read from the average curve.

t°	Gms. NaBr per 100 gms. sat. sol.	Solid Phase	t°	Gms. NaBr per 100 gms. sat. sol.	Solid Phase
-45	9.1	NaBr. $\cdot NH_3$	25	28	NaBr. $\cdot NH_3$
-40	12.0	"	15	27.5	NaBr
-34 (d= 7906)	16.0	"	50	27	"
-30	19.0	"	75	24.5	"
-20	26.5	"	100	23.5	"
-10	34.0	"	120	22	"
0	41.5	"	140	20	"
+10	49.0	"	160	21	"

EQUILIBRIUM IN THE SYSTEM SODIUM BROMIDE, SODIUM CHLORIDE AND LIQUID AMMONIA AT 0°.

(Portnow and Rawdine, 1937.)

Gms. per 100 gms. sat. sol.			Solid Phase	Gms. per 100 gms. sat. sol.			Solid Phase
NaCl	NaBr	NH ₃		NaCl	NaBr	NH ₃	
0.0	39.0	61.0	NaBr	5.39	28.32	66.29	NaCl
1.74	37.85	60.31	"	6.61	21.26	72.13	"
3.61	35.96	60.43	" + NaCl	8.19	16.07	75.74	"
4.12	35.42	63.55	NaCl	10.20	5.94	83.86	"
4.54	31.91	65.55	"	11.60	0.0	88.40	"

100 gms. liquid Sulfur Dioxide (SO₂) dissolve 0.016 gm. NaBr at 0°
(Jander and Ruppolt, 1937.)

Fusion-point data are given for:

- NaBr + NaCl (Amadori, 1912(a); Ruff and Plate, 1903.)
- " + NaI (Amadori, 1912a)
- " + NaF (Ruff and Plate, 1903.)
- " + NaOH (Scarpa, 1915.)
- " + NaNO₂ (Meneghini, 1912.)
- " + Na₂SO₄ (Ruff and Plate, 1903.)
- " + SrBr₂ (Kellner, 1917.)

SODIUM BROMATE NaBrO₃.

BrO

SOLUBILITY OF SODIUM BROMATE IN WATER.

(Ricci, 1934.)

t°	d. of sat. sol.	Gms. NaBrO ₃ per 100 gms. sat. sol.	t°	d. of sat. sol.	Gms. NaBrO ₃ per 100 gms. sat. sol.
5	1.194	21.42	35	1.288	31.35
10	1.211	23.34	40	1.310	32.80
15	1.232	24.94	50	—	35.55
20	1.248	26.69	60	—	38.5 (Kremers, 1855-56a)
25	1.257	28.29	80	—	43.1 " "
30	1.284	29.85	100	—	47.6 " "

The solid phase is NaBrO₃ in all cases.

EQUILIBRIUM IN THE SYSTEM SODIUM BROMATE, SODIUM CHLORATE AND WATER AT 25°.

(Swenson and Ricci, 1939.)

Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase
NaBrO ₃	NaClO ₃		NaBrO ₃	NaClO ₃	
28.29	0.0	NaBrO ₃	5.33	44.64	SSII, 40.4
16.46	18.91	"	5.07	44.98	" 64.2
12.20	28.03	"	4.49	45.66	" 71.0
8.68	36.75	"	3.79	46.46	" 83.2
7.14	40.98	"	3.69	46.56	" 85.0
7.00	41.47	S.S.I 2.02	2.84	47.42	" 89.4
6.54	42.62	" 1.70	1.89	48.36	" 91.0
5.99	43.66	" 6.84	0.96	49.16	" 98.0
6.05	43.55	" 24.3 +	0.79	49.36	" 98.5
		S.S.II(?)	0.0	50.07	NaClO ₃

S.S.I and S.S.II indicate solid solutions and the figures which follow show the percentage of NaClO₃ found in these by analysis. Less complete results than the above are given for the 50° isotherms.

EQUILIBRIUM IN THE SYSTEM SODIUM BROMATE, SODIUM CHLORIDE AND WATER.
(Piccol. 1934.)

Results at 10°				Results at 20°			
d. of	Gms. per 100 gms.		Solid Phase	d. of	Gms. per 100 gms.		Solid Phase
sat.	sat. sol.			sat.	sat. sol.		
sol.	NaCl	NaBrO ₃		sol.	NaCl	NaBrO ₃	
1.211	0.00	33.24	NaBrO ₃	1.241	4.76	24.74	NaBrO ₃
1.193	4.85	17.28	"	1.229	6.17	20.37	"
1.192	9.84	12.75	"	1.225	9.98	16.31	"
1.199	16.15	8.58	"	1.228	13.95	14.67	"
1.213	20.75	6.41	"	1.214	17.57	10.44	"
1.229	23.61	5.32	"	1.214	20.99	8.42	"
1.235	24.53	5.02	" + NaCl	1.217	23.94	6.92	" + NaCl
—	26.32	0.0	NaCl	1.216	26.42	5.62	NaCl
				1.216	29.56	2.48	"

EQUILIBRIUM IN THE SYSTEM SODIUM BROMATE, SODIUM CHLORIDE
AND WATER AT 30°.
(Piccol. 1934.)

NaBrO ₃ -NaCl				NaBrO ₃ -NaBr			
d. of	Gms. per 100 gms.		Solid Phase	d. of	Gms. per 100 gms.		Solid Phase
sat.	sat. sol.			sat.	sat. sol.		
sol.	NaCl	NaBrO ₃		sol.	NaCl	NaBrO ₃	
1.257	0.0	28.29	NaBrO ₃	1.227	24.89	14.24	NaBrO ₃
1.332	17.32	16.57	"	1.316	26.66	11.44	"
1.438	32.21	8.92	"	1.374	29.14	11.30	"
1.521	40.76	5.78	"	1.414	24.00	11.17	" + NaCl
1.619	48.11	3.62	"	1.404	24.71	0.0	NaCl

BrO

EQUILIBRIUM IN THE SYSTEM SODIUM BROMATE
SODIUM NITRATE AND WATER AT 30°.
(Piccol. 1934.)

TABLE I				TABLE II			
d. of	Gms. per 100 gms.		Solid Phase	d. of	Gms. per 100 gms.		Solid Phase
sat.	sat. sol.			sat.	sat. sol.		
sol.	NaNO ₃	NaBrO ₃		sol.	NaNO ₃	NaBrO ₃	
1.270	5.00	24.92	NaBrO ₃	1.441	19.57	10.34	NaBrO ₃
1.288	11.33	21.25	"	1.455	22.59	9.48	" + NaNO ₃
1.314	18.48	17.79	"	1.442	24.96	6.04	NaNO ₃
1.353	25.54	14.94	"	1.405	26.50	2.91	"
1.387	32.54	13.41	"	1.384	27.82	0.0	"

EQUILIBRIUM IN THE SYSTEM SODIUM BROMATE
SODIUM SULFATE AND WATER.

(Piccol. 1934. 1936.)

Results at 10°

Results at 25°

d. of	Gms. per 100 gms.		Solid Phase	d. of	Gms. per 100 gms.		Solid Phase
sat.	sat. sol.			sat.	sat. sol.		
sol.	Na ₂ SO ₄	NaBrO ₃		sol.	Na ₂ SO ₄	NaBrO ₃	
1.217	1.83	21.96	NaBrO ₃	1.284	4.09	24.96	NaBrO ₃
1.226	3.61	20.67	"	1.288	8.48	21.72	"
1.227	4.40	20.11	" + Na ₂ SO ₄	1.304	12.15	18.71	"
1.230	4.41	19.93	Na ₂ SO ₄	1.317	15.05	15.85	"
1.175	5.20	14.21	"	1.224	19.17	7.07	" + Na ₂ SO ₄
1.112	6.96	5.40	"	1.225	20.48	4.34	Na ₂ SO ₄
1.079	8.26	0.0	"	1.205	21.90	0.0	"

Na₂SO₄ = Na₂SO₄ · 10H₂O.

EQUILIBRIUM IN THE SYSTEM SODIUM BROMATE, SODIUM SULFATE
AND WATER AT 45°.

(Ricci, 1935.)

Gms. per 100 gas. sat. sol.		Solid Phase	Gms. per 100 gas. sat. sol.		Solid Phase
Na_2SO_4	NaBrO_3		Na_2SO_4	NaBrO_3	
0.0	34.22	NaBrO_3	22.92	14.38	S. S.
8.10	27.14	"	24.18	12.56	"
16.54	20.38	"	25.85	10.13	"
19.81	17.93	"	26.56	9.23	"
21.09	17.03*	"	27.76	7.53	"
21.59	16.62*	"	29.21	5.85*	"
22.47	16.00*	"	29.52	5.45*	"
20.86	17.17	" + S. S.	19.89	29.95	5.01*
20.94	17.0	S. S.	17.17	30.44	4.50*
21.58	15.96	"	14.40	28.78	6.32
22.77	14.65	"	13.80	29.18	5.64
			30.95	3.12	"

* = Metastable. S. S. = Solid Solutions containing the indicated percentages of NaBrO_3 .

Similar results are also given for the isotherms 30°, 37.5° and 52°.

This system provides a sixth type of solid solution in addition to the five possible types described by Roozeboom.

100 cc. anhydrous Hydrazine dissolve 1.0 gms. NaBrO_3 with decomposition. (Welsh and Broderston, 1915.)

SODIUM METHIONATE $\text{Na}_2[\text{CH}_2(\text{SO}_3)_2] \cdot 2\text{H}_2\text{O}$.SODIUM Chloro METHIONATE $\text{Na}_2[\text{CHCl}(\text{SO}_3)_2] \cdot \text{H}_2\text{O}$.

SOLUBILITY OF EACH SEPARATELY IN WATER.

(Backer and Terpstra, 1929; Backer, 1930.)

t°	Gms. anhydrous compound per 100 gas. H_2O	Solid Phase
25	38.4	$\text{Na}_2[\text{CH}_2(\text{SO}_3)_2] \cdot 2\text{H}_2\text{O}$
25	127.0	$\text{Na}_2[\text{CHCl}(\text{SO}_3)_2] \cdot \text{H}_2\text{O}$

SODIUM FORMATE HCOONa .

THE FREEZING-POINTS OF AQUEOUS SOLUTIONS OF SODIUM FORMATE.

(Sidgwick and Gentile, 1922.)

t of f. pt.	-3.29.	7.02.	-11.02.	-18.03.
Gms. HCOONa per 100 gms. sat. sol.	7.24	11.42	16.95	24.86

SOLUBILITY IN WATER.

(Groschuff, 1903.)

t°.	Gms. HCOONa per 100 Gms. Solution.	Mols. HCOONa per 100 Mols. H_2O .	Solid Phase.	t°.	Gms. HCOONa per 100 Gms. Solution.	Mols. HCOONa per 100 Mols. H_2O .	Solid Phase.
-20	22.80	7.82	$\text{HCOONa} \cdot 3\text{H}_2\text{O}$	25.5	50.53	27.0	$\text{HCOONa} \cdot 2\text{H}_2\text{O}$
0	30.47	11.6	"	18	49.22	25.65	HCOONa
+15	41.88	19.1	"	29	50.44	26.9	"
18	44.92	21.6	"	54	53.80	30.8	"
18	44.73	21.4	$\text{HCOONa} \cdot 2\text{H}_2\text{O}$	74.5	56.82	34.8	"
21	46.86	23.3	"	100.5	61.54	42.35	"
23	48.22	24.65	"	123	66.20	51.8	"

Sp. Gr. of the saturated solution of the dihydrate at 18° = 1.217.

SOLUBILITY OF SODIUM ACID FORMATE (EXPRESSED AS NEUTRAL
SALT) IN AQUEOUS SOLUTIONS OF FORMIC ACID.

(Groschuff.)

t°.	Gms. HCOONa per 100 Gms. Solution.	Mols. HCOONa per 100 Mols. H ₂ O.	Solid-Phase.	t°.	Gms. HCOONa per 100 Gms. Solution.	Mols. HCOONa per 100 Mols. H ₂ O.	Solid-Phase.
0	22.35	19.5	HCOONa.HCOOH	45.5	38.85	43.1	HCOONa
25.5	29.62	28.45	"	70	41.27	47.5	"
66.5	41.08	47.1	"	85	43.09	51.2	"

SOLUBILITY OF SODIUM FORMATE IN WATER.

(Elbs and Tremmel, 1897.)

The original results were plotted together with those of Groschuff and the following values taken from the average curves which coincide except in the region of the dihydrate.

CH

t°	Gms. NaHCOO per 100 gms. sat. sol.		Solid Phase	t°	Gms. NaHCOO per 100 gms. sat. sol.		Solid Phase
	E and T	Groschuff			E and T	Groschuff	
10	38.5	38.5	NaHCOO. 3H ₂ O	22	46.0	47.5	NaHCOO. 2H ₂ O
12.0	39.5	39.5	"	24	47.4	49.0	"
14	41.0	41.0	"	26.5	—	49.8	" + NaHCOO
15	41.8	41.8	"	27.9	50.3	—	"
15.3	42.4	—	" + NaHCOO. 2H ₂ O	30	50.6	50.6	NaHCOO
15.9	—	44.0	"	40	52.0	52.0	"
18	43.5	45.0	NaHCOO. 2H ₂ O	50	53.4	53.4	"
20	44.8	46.2	"	60	55.0	55.0	"

EQUILIBRIUM IN THE SYSTEM SODIUM FORMATE, FORMIC ACID AND WATER.

(Elbs and Tremmel, 1897.)

Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase
HCOOH	HCOONa		HCOOH	HCOONa	

Results at 13°			Results at 23.4°		
0.0	39.8	NaHCOO. 3H ₂ O	0.0	46.7	NaHCOO. 2H ₂ O
10.6	43.7	"	5.7	48.5	"
11.7	43.3	3NaHCOO. HCOOH	6.55	49.15	" + 3NaHCOO.
12.7	43.1	"	40.8	51.3	NaHCOO. HCOOH +
14.1	42.4	"	71.1	58.9	NaHCOO. HCOOH
24.8	40.8	"	Results at 45°		
35.4	37.8	"	0.0	47.3	NaHCOO
39.2	37.2	NaHCOO. HCOOH	2.4	45.1	"
54.8	31.2	"	9.25	38.25	" + 3NaHCOO.
74.0	26.0	"	49.58	9.59	NaHCOO. HCOOH +
			65.1	0.0	NaHCOO. HCOOH

F. pt. data for the system Sodium Formate, Formic Acid are given by Kendall and James, 1921.

SODIUM FORMATE

100 gms. Methyl Alcohol (CH_3OH) dissolve 3.52 gms. anhydrous NaHCOO at 15° and 3.68 gms. at the b. pt. (66.6°). (Henstock, 1934.)

SODIUM FORMALDEHYDE SULFOXALATE $\text{NaHSO}_2 \cdot \text{CH}_2\text{O} \cdot 2\text{H}_2\text{O}$.

100 cc. sat. solution of sodium formaldehyde sulfoxalate in glycerol of $d = 1.262$ contain 50.66 gms. sulfoxalate at 18° and the density of the saturated solution is 1.375.

100 cc. sat. solution of sodium formaldehyde sulfoxalate in methyl alcohol of $d = 0.8$ contain 8.39 gms. sulfoxalate at 18° and the density of the saturated solution is 0.845. (Höyl and Greer, 1922.)

SODIUM ACETATE $\text{CH}_3\text{COONa} \cdot 3\text{H}_2\text{O}$.**SOLUBILITY IN WATER.**

(Green, 1908.)

t° .	Gms. CH_3COONa per 100 Gms. H_2O .	Solid Phase.	t° .	Gms. CH_3COONa per 100 Gms. H_2O .	Solid Phase.
-10	19	Ice	20	123.5	CH_3COONa (unstable)
-18	30.4		30	126	"
-10	33		40	129.5	"
0	36.3		50	134	"
+10	40.8		60	139.5	"
20	46.5	"	70	146	"
30	54.5	"	80	153	"
40	65.5	"	90	161	"
50	83	"	100	170	"
58	138	"	110	180	"
0	119	CH_3COONa (unstable)	120	191	"
10	121	"	123 b. pt.	193	"

Results differing somewhat from the above are given by Köhler (1897); Enklaar (1901) and Schiavor (1902).

SODIUM ACETATE $\text{CH}_3\text{COONa} \cdot 3\text{H}_2\text{O}$.**FREEZING-POINTS OF AQUEOUS SOLUTIONS OF SODIUM ACETATE.**

Results by Klein and Svanberg, 1920.

Results by Sidgwick and Gentile, 1922.

t° of f. pt.	Gms. CH_3COONa . per 100 cc. sat. sol.	Solid Phase.	t° of f. pt.	Gms. CH_3COONa . per 100 gms. sat. sol.	Solid Phase.
-0.36.....	0.82	Ice	-2.96.....	6.107	Ice
-0.91.....	2.05		-6.42.....	11.27	
-1.85.....	4.10		-11.12.....	16.62	
			-15.17.....	20.57	"

SOLUBILITY OF SODIUM ACETATE IN AQUEOUS SOLUTIONS OF ACETIC ACID AT
VARIOUS TEMPERATURES.
(Dunningham, 1912.)

Results at 0°.		Results at 15°.		Results at 30°.		Results at 75°.		Solid Phase in Each Case.
Gms. per 100 Sat. Solution.		Gms. per 100 Gms. Sat. Solution.		Gms. per 100 Gms. Sat. Solution.		Gms. per 100 Gms. Sat. Solution.		
Na ₂ O.	(CH ₃ CO) ₂ O.	Na ₂ O.	(CH ₃ CO) ₂ O.	Na ₂ O.	(CH ₃ CO) ₂ O.	Na ₂ O.	(CH ₃ CO) ₂ O.	
...	...	20.34	0.15	35.31	0.77	44.45	0.76	CH ₃ COONa
...	...	...	...	26.25	8.92	32.47	5.03	"
...	...	...	...	...	...	22.30	36.60	"
24.12	2.04	25.04	4.10	25.08	9.06	...	...	CH ₃ COONa.3H ₂ O
14.46	8.55	15.49	12.01	18.09	13.62	...	...	"
9.72	31	11.45	23.54	13.53	21.88	...	...	"
9.77	41.23	11.25	34.56	13.24	33.05	...	...	" +1.1
9.04	43.94	10.33	39.08	13.14	32.90	17.85	43.06	1.1
...	...	10.22	39.73	7.64	65.07	11.05	65.71	"
...	...	9.16	49.32	...	...	7.63	81.40	"
...	...	...	...	...	...	0.44	98.35	"
8.96	44.80	8.56	54.34	7.67	66.42	...	...	" +1.2
8.72	45.10	7.06	61.63	7.33	69.68	...	...	1.2
7.83	50.03	5.95	70.55	6.61	72.85	...	...	"
6.19	62.44	4.84	77.60	5.52	77.76	...	...	"
4.02	70.29	2.87	86.61	3.78	83.92	...	...	"
1.05	92.29	1.02	95.87	2.04	86.73	...	...	"
0.42	97.51	0.79	98.00	1.27	94.78	...	...	"

1.1 = CH₃COONa.CH₃COOH. 1.2 = CH₃COONa.2CH₃COOH.

Additional data for 5°, 20°, 45° and 60° are also given.

Similar data for 30° are given by Dukelski (1909), and for 20° by Abe (1911-12). One determination at 25°, expressed in terms of volume of solution, is given by Herz (1911-12). Two determinations at 10° similarly expressed, are given by Enklaar (1901).

SOLUBILITY OF SODIUM ACETATE IN PURE ACETIC ACID,
DETERMINED BY THE FREEZING-POINT METHOD.
(Kendall and Adler, 1921.)

t°	Mol. % CH ₃ COONa in sat. solution	Solid Phase	t°	Mol. % CH ₃ COONa in sat. solution	Solid Phase
16.5	0.0	CH ₃ COOH	96.1	10.72	CH ₃ COONa.2CH ₃ COOH
16.1	0.83	"	96.25	11.03	"
14.3	3.59	"	96.3	11.16	"
13.1	5.40	"	113.0	14.03	CH ₃ COONa.CH ₃ COOH
25.3	7.11	CH ₃ COONa.2CH ₃ COOH	(128.5)	41.1	"
(9.0)	(7.51)	"	132.0	36.87	"
36.7	8.92	"	145.2	39.06	"
54.3	12.17	"	157.0	42.54	"
(55.0)	(14.99)	"	160.6	44.25	"
66.9	15.27	"	162.1	46.28	"
71.9	16.58	"	174.0	48.76	CH ₃ COONa
(81.0)	(23.46)	"	195.5	49.99	"
85.7	21.55	"			
(92.0)	(33.01)	"			
93.2	26.86	"			

The results in parentheses, differing somewhat from those of Kendall and Adler are by Rakunin and Vitale, 1935.

Results for this system are also given by Vassilev, 1909.

Data for equilibrium in the system

Sodium Acetate + Lead Acetate + Acetic Acid at 30°
are given by Griswold and Olson, 1934.

Data for equilibrium in the system

Sodium Acetate + Zinc Acetate + Acetic Acid, Determined by the
Freezing-point method, are given by Davidson and McAllister, 1930.

SOLUBILITY OF SODIUM ACETATE IN AQUEOUS ETHYL ALCOHOL AT 25°.
(Seidell, 1910.)

Wt. Per cent C ₂ H ₅ OH in Solvent.	<i>d</i> ₂₅ of Sat. Sol.	Gms. CH ₃ COO- Na.3H ₂ O per 100 Gms. Sat. Sol.	Wt. Per cent C ₂ H ₅ OH in Solvent.	<i>d</i> ₂₅ of Sat. Sol.	Gms. CH ₃ COO- Na.3H ₂ O per 100 Gms. Sat. Sol.
0	1.209	55.7	60	0.990	30.4
10	1.160	53	70	0.942	22.8
20	1.135	49.8	80	0.882	13
30	1.108	46.5	90	0.838	6.7
40	1.072	42	95	0.828	6.1
50	1.038	37	100	0.823	7.3

The solid phase in contact with the solution was CH₃COONa.3H₂O in all cases.

100 gms. absolute alcohol dissolve 7.49 gms. CH₃COONa.3H₂O at room temp.
(Böttker, 1897.)

SOLUBILITY OF SODIUM ACETATE IN AQUEOUS ALCOHOL:

At 18°.
(Gerardin, 1865.)

At Different Temperatures.
(Schiavor, 1902.)

Wt. Per cent Alcohol.	Gms. CH ₃ COONa per 100 Gms. Aq. Alcohol.	t°.	Degree of Alcohol.	Gms. per 100 Gms. Alcohol.	
				CH ₃ COONa.	CH ₃ COONa.3H ₂ O.
5.2	38	8	98.4	2.08	3.45
9.8	35.9	12	98.4	2.12	3.51
23	29.8	19	98.4	2.33	3.86
29	27.5	11	90	2.07	3.42
38	23.5	13	90	2.13	3.52
45	20.4	15	63	13.46	22.32
59	14.6	18	63	13.88	23.03
86	3.9	21	63	14.65	24.30
91	2.1	23	40	28.50	47.27

100 gms. H₂O dissolve 237.6 gms. sugar + 57.3 gms. CH₃COONa, or 100 gms. of the saturated solution contain 58.93 gms. sugar + 14.44 gms. CH₃COONa at 31.25°.
(Köhler, 1897.)

100 cc. anhydrous hydrazine dissolve 6 gms. sodium acetate at room temp.
(Welsh and Broderson, 1915.)

100 gms. propyl alcohol dissolve 0.97 gm. sodium acetate.
(Schlamp, 1894.)

100 gms. Methyl Alcohol (CH₃OH) dissolve 16.0 gms. anhydrous sodium acetate at 15° and 16.45 gms. at 17.7°. (b.pt.)

100 gms. Acetone ((CH₃)₂CO) dissolve 0.05 gms. anhydrous sodium acetate at 15°.
(Henstock, 1934.)

The composition of the homogeneous mixture (plait point) of the system Sodium Acetate, Tertiary Butyl Alcohol and Water at 25° was found by Ginnings, Herring and Webb, 1933, to be

4.7 percent CH₃COONa + 38.0 percent t (CH₃)₃COH + 57.3 percent H₂O.

The original results for other points on the binodal curve are not given but only the values corresponding to derived empirical equations for the curve. The triangular diagram but no numerical values are given by Jencie, 1934, for the system Sodium Acetate + Phenol + Water at 25°.

100 gms. liquid Sulfur Dioxide (SO₂) dissolve 0.073 gm. NaCH₃COO at 0°.
(Jander and Ruppolt, 1937.)

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SODIUM Phenyl ACETATE $\text{CH}_3\text{C}_6\text{H}_5\text{COONa}$.

Freezing-point data for the systems:

Sodium Phenyl Acetate + Phenyl Acetic Acid
 " " " + Phenyl Acetic Anhydride
 and " " " + Ethyl Phenyl Acetate
 are given by Bakunin and Vitale, 1935.

SODIUM PROPIONATE $\text{CH}_3\text{CH}_2\text{COONa}$.

100 gms. Methyl Alcohol (CH_3OH) dissolve 13.38 gms. $\text{CH}_3\text{CH}_2\text{COONa}$ at 15° and 13.77 gms. at 68.0° . (b.pt.) (Henstock, 1934.)

The triangular diagram but no numerical values are given by Jenci 1934, for the system Sodium Propionate + Phenol + Water at 25° .

SODIUM BUTYRATE $\text{C}_4\text{H}_7\text{COONa}$.

EQUILIBRIUM IN THE SYSTEM SODIUM HYDROXIDE, BUTYRIC ACID
 AND WATER AT 25° .
 (Bury and Owens, 1935.)

	Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase
	Na_2O	$(\text{C}_4\text{H}_7\text{O}_2)$		Na_2O	$(\text{C}_4\text{H}_7\text{O}_2)$	
CH	40.56	0.0	$\text{NaOH} \cdot \text{H}_2\text{O}$	15.00	37.22	$\text{C}_4\text{H}_7\text{CO}_2\text{Na} \cdot \text{H}_2\text{O}$
	40.62	0.77	" + $\text{C}_4\text{H}_7\text{CO}_2\text{Na}$	15.10	32.97	"
	39.01	0.50	$\text{C}_4\text{H}_7\text{CO}_2\text{Na}$	14.31	37.77	"
	33.88	0.76	"	14.27	41.34	"
	29.05	0.58	"	14.19	43.66	"
	23.81	1.00	"	13.92	46.44	"
	20.38	3.09	"	13.82	49.76	"
	19.29	6.50	"	13.47	52.07	$3\text{C}_4\text{H}_7\text{CO}_2\text{Na} \cdot \text{C}_4\text{H}_7\text{CO}_2\text{Na}$
	18.86	11.66	$\text{C}_4\text{H}_7\text{CO}_2\text{Na} \cdot \text{H}_2\text{O}$	12.40	60.72	"
	17.24	17.93	"	11.03	74.63	"
	16.89	20.70	"	10.69	79.92	"
	16.53	24.01	"	10.35	82.28	"

EQUILIBRIUM IN THE SYSTEM SODIUM BUTYRATE AND BUTYRIC ACID,
 DETERMINED BY THE FREEZING-POINT METHOD.
 (Bakunin and Vitale, 1935.)

t°	Mol. % $\text{C}_4\text{H}_7\text{CO}_2\text{Na}$ in sat. solution	Solid Phase	t°	Mol. % $\text{C}_4\text{H}_7\text{CO}_2\text{Na}$ in sat. solution	Solid Phase
- 6	7.11	$\text{C}_4\text{H}_7\text{COOH}$	155	53.14	X.1
- 13	14.56	"	196	67.80	"
- 22	22.12	"	206	72.63	"
- 27 Eutec.	—	" + 1.1	225	82.12	"
+ 20	29.76	1.1	238	92.90	$\text{C}_4\text{H}_7\text{CO}_2\text{Na}$
83.1	39.51	X.1	286 m.pt.	100.00	"
127.0	47.22	"			

1.1 = $\text{C}_4\text{H}_7\text{COONa} \cdot \text{C}_4\text{H}_7\text{COOH}$; X.1 = $\text{XC}_4\text{H}_7\text{COONa} \cdot \text{C}_4\text{H}_7\text{COOH}$.

100 gms. Methyl Alcohol (CH_3OH) dissolve 15.31 gms. $\text{C}_4\text{H}_7\text{COONa}$ at 15° and 20.70 gms. at 68.5° (b.pt.).

100 gms. Acetone ($(\text{CH}_3)_2\text{CO}$) dissolve 0.14 gm. $\text{C}_4\text{H}_7\text{COONa}$ at 15° .
 (Henstock, 1934.)

SODIUM TARTRATES**SOLUBILITY IN WATER.**

Salt.	Formula.	t°.	Gms. Salt per 100 Gms. H ₂ O.	Authority.
Sodium Neutral Inactive Pyrotartrate	$C_4H_4O_6 \cdot Na_2 \cdot 6H_2O$	20	39.73	(Schlossberg, 1900.)
" Dextro "	" "	20	41.10	" "
Sodium Dihydroxy Tartrate	$C_4H_4O_6 \cdot Na_2 \cdot 3H_2O$	0	0.039	(Fenton, 1898.)

The composition of the homogeneous mixture (plait point) of the system, Sodium Tartrate, Tertiary Butyl Alcohol and Water at 25° was found by Ginnings, Herring and Webb, 1933, to be

3.8 percent $Na_2C_4H_4O_6$ + 31.4 percent $\frac{1}{2}(CH_3)_3COH$ + 66.8 percent H_2O .

Similar results for the system Sodium Potassium Tartrate, Tertiary Butyl Alcohol and water at 25° are

4.0 percent $NaKC_4H_4O_6$ + 31.1 percent $\frac{1}{2}(CH_3)_3COH$ + 64.9 percent H_2O .

The original results for other points on these binodal curves are not given but only the values corresponding to derived empirical equations for the curves.

100 gms. Acetone ($(CH_3)_2CO$) dissolve 6.7 gms. $NaKC_4H_4O_6$ at 15°.
(Henstock, 1934.)

SODIUM FUMARATES; Neutral, $Na_2C_4H_2O_4$; Acid, $NaC_4H_3O_4$.

100 gms. H_2O dissolve 22.83 gms. neutral sodium fumarate at 25°.

100 gms. H_2O dissolve 6.87 gms. acid sodium fumarate at 25°, 10.74 gms. at 40°
18.15 gms. at 60° and 30.2 gms. at 100°.
(Weiss and Downs, 1923.)

SODIUM MALEATE $Na_2C_4H_2O_4 \cdot \frac{1}{2}H_2O$.

100 gms. H_2O dissolve 96.06 gms. $Na_2C_4H_2O_4$ at 25°. (Weiss and Downs, 1923.)

SODIUM Acid MALEATE $NaC_4H_3O_4 \cdot 3H_2O$.

100 gms. H_2O dissolve 6.73 gms. $NaC_4H_3O_4$ at 25°, 12.81 gms. at 40°, 31.3 gms. at 60° and 288.0 gms. at 100°.
(Weiss and Downs, 1923.)

SODIUM CACODYLATE $(CH_3)_2AsO.ONa$.

100 gms. H_2O dissolve about 200 gms. of the salt at 15°–20°. (Squire and Caines, 1905.)
100 cc. 90% alcohol dissolve about 100 gms. of the salt at 15°–20°. " "

SODIUM SUCCINATE $(CH_2)_2(COONa)_2 \cdot 6H_2O$.**SOLUBILITY IN WATER.** (Marshall and Bain, 1910.)

t°	Gms. $(CH_2)_2$ - $(COONa)_2$ per 100 Gms. H_2O .	Solid Phase.	t°.	Gms. $(CH_2)_2$ - $(COONa)_2$ per 100 Gms. H_2O .	Solid Phase.
0	21.45	$(CH_2)_2(COONa)_2 \cdot 6H_2O$	50	56.3	$(CH_2)_2(COONa)_2 \cdot 6H_2O$
12.5	27.38	"	62.5	78.49	"
25	34.90	"	64.9	83.38	" + $(CH_2)_2(COONa)_2$
37.5	43.64	"	75	86.63	$(CH_2)_2(COONa)_2$

SOLUBILITY OF SODIUM HYDROGEN SUCCINATE IN WATER.
 (Marshall and Bain, 1910.)

t°.	Gms. (CH ₂) ₂ - (COOH)(COONa) per 100 Gms. H ₂ O.	Solid Phase.	t°.	Gms. (CH ₂) ₂ - (COOH)(COONa) per 100 Gms. H ₂ O.	Solid Phase.
0	17.55	NaHSu*·3H ₂ O	38.7	63.99	NaHSu·3H ₂ O + NaHSu
2.5	27.93	"	50	67.37	NaHSu
25	39.82	"	62.5	70.15	"
37.5	60.01	"	75	80	"

 EQUILIBRIUM IN THE SYSTEM SODIUM SUCCINATE, SUCCINIC ACID AND WATER.
 (Marshall and Bain, 1910.)

	Results at 0°.		Results at 25°.	
	Gms. per 100 Gms. Sat. Sol.		Gms. per 100 Gms. Sat. Sol.	
	Na ₂ Su.	H ₂ Su.	Na ₂ Su.	H ₂ Su.
0	2.68	H ₂ Su*	0	7.71
3.23	4.76	"	3.68	10.26
5.38	5.83	"	8.99	13.35
8.27	7.12	" + NaHSu·3H ₂ O	12.64	15.53
8.67	6.27	NaHSu·3H ₂ O	15.26	16.90
9.68	4.74	"	15.97	13.83
11.74	3.49	"	18.89	8.41
15.62	2.34	"	22.71	5.65
18.36	1.90	" + Na ₂ Su 6H ₂ O	26.88	4.08
18.07	1.67	Na ₂ Su 6H ₂ O	26.50	2.38
17.87	0.94	"	26.11	0.85
17.64	...	"	25.87	0
	Results at 50°.		Results at 75°.	
	Na ₂ Su.	H ₂ Su.	Na ₂ Su.	H ₂ Su.
	Na ₂ Su.	H ₂ Su.	Na ₂ Su.	H ₂ Su.
0	19.27	H ₂ Su*	0	37.64
5.95	22.90	"	8.22	40.38
10.25	25.33	"	13.14	42.50
15.49	28.73	"	16.93	44.38
19.65	31.73	" + NaHSu	19.56	45.98
20.72	26.51	NaHSu	21.88	35.60
22.53	18.44	"	24.30	26.82
25.53	13.09	"	29.45	15.28
28.28	9.46	"	36.11	7.79
30.48	7.38	"	41.26	4.93
37.33	4.20	" + Na ₂ Su 6H ₂ O	45.27	4
36.85	3.88	Na ₂ Su 6H ₂ O	45.36	3.17
36.67	2.66	"	45.93	1.23
36.43	0	"	46.42	0

The following double and triple points were located:

t°.	Gms. per 100 Gms. Sat. Sol.		Solid Phase
	Na ₂ Su.	H ₂ Su.	
34.9	30.8	5.6	NaHSu·3H ₂ O + NaHSu + Na ₂ Su 6H ₂ O
37.8	19.6	25.46	NaHSu·3H ₂ O + NaHSu + H ₂ Su
38.7	22.47	16.44	NaHSu·3H ₂ O + NaHSu
63.4	42.92	3.64	Na ₂ Su 6H ₂ O + Na ₂ Su H ₂ O + NaHSu
64.9	45.43	...	Na ₂ Su 6H ₂ O + Na ₂ Su H ₂ O

*In the above tables the abbreviation Su is used for (CH₂)₂(COO)₂.

100 gms. Methyl Alcohol (CH_3OH) dissolve 0.72 gms. anhydrous $(\text{CH}_2)_2(\text{COONa})_2$ at 15° and 1.80 gms. at 66.6° (b.pt.). (Henstock, 1934.)

SODIUM β Methyl ADIPATE (Racemic).

100 gms. sat. solution in water contain 36.8 gms. of the salt at 20° . (Mourisse.)

SODIUM URATE $\text{C}_5\text{H}_3\text{N}_4\text{O}_3\text{Na}$.

SOLUBILITY IN AQUEOUS SODIUM CHLORIDE AT 37° .

(d'Agostino, 1910.)

Gms. Mols. per Liter.		Gms. Mols. per Liter.		Gms. Mols. per Liter.	
NaCl.	$\text{C}_5\text{H}_3\text{N}_4\text{O}_3\text{Na}$.	NaCl.	$\text{C}_5\text{H}_3\text{N}_4\text{O}_3\text{Na}$.	NaCl.	$\text{C}_5\text{H}_3\text{N}_4\text{O}_3\text{Na}$.
0	0.00536	0.01084	0.00211	0.05116	0.00050
0.00486	0.00340	0.01398	0.00172	0.06667	0.00034
0.00532	0.00321	0.02564	0.00102	0.07363	0.00032
0.00865	0.00256	0.04012	0.00054	0.08595	0.00026

One liter of H_2O dissolves 1.5 gms. sodium urate at 37° . (Bechhold and Ziegler, 1910.)

One liter of serum dissolves 0.025 gm. sodium urate at 37° . " " "

SOLUBILITY OF SODIUM URATE IN AQUEOUS SOLUTIONS OF $\text{KH}_2\text{PO}_4 + \text{K}_2\text{HPO}_4$ AT 37° . (Jung, 1923.)

p_{H} of aq. phosphate solution.	5.0.	5.6.	6.4.	6.6.	7.0.
Gms. $\text{C}_5\text{H}_3\text{N}_4\text{O}_3\text{Na}$ per liter of solvent...	0.25	0.675	0.93	1.15	1.13

SODIUM CITRATE $(\text{CH}_2)_2\text{COH}(\text{COONa})_2 \cdot \frac{1}{2}\text{H}_2\text{O}$.

SOLUBILITY IN AQUEOUS ETHYL ALCOHOL AT 25° .

(Seidell, 1910.)

Wt. Per cent $\text{C}_2\text{H}_5\text{OH}$ in Solvent.	d_{25} of Sat. Sol.	Gms. $\text{C}_6\text{H}_5\text{O}_7\text{Na}_3 \cdot \frac{1}{2}\text{H}_2\text{O}$ per 100 Gms. Sat. Sol.	Wt. Per cent $\text{C}_2\text{H}_5\text{OH}$ in Solvent.	d_{25} of Sat. Sol.	Gms. $\text{C}_6\text{H}_5\text{O}_7\text{Na}_3 \cdot \frac{1}{2}\text{H}_2\text{O}$ per 100 Gms. Sat. Sol.
0	1.276	48.1	40	0.953	4.5
10	1.190	37.4	50	0.918	1.4
20	1.100	25	60	0.892	0.3
30	1.006	11.8	100	0.789	0

Data for equilibrium in the system sodium hydroxide, citric acid, phosphoric acid and water at 20° are given by Pratolongo (1913).

The author fails to describe clearly the terms in which the results are expressed, consequently their exact meaning is not clear.

SODIUM CAPROATE $\text{CH}_3(\text{CH}_2)_4\text{COONa}$

The triangular diagram but no numerical results for the system Sodium Caproate, Phenol and Water at 25° are given by Jencic, 1934.

SODIUM PHENOLATES, $\text{C}_6\text{H}_5\text{ONa} \cdot 3\text{H}_2\text{O}$ and $\text{C}_6\text{H}_5\text{ONa} \cdot 2\text{C}_6\text{H}_5\text{OH}$.

EQUILIBRIUM IN THE SYSTEM SODIUM HYDROXIDE, PHENOL AND WATER AT 25° . (von Meurs, 1916.)

Mols. per 100 mols. sat. sol.		Solid Phase	Mols. per 100 mols. sat. sol.		Solid Phase
NaOH.	$\text{C}_6\text{H}_5\text{OH}$.		NaOH.	$\text{C}_6\text{H}_5\text{OH}$.	
33.92	0.0	NaOH. $\cdot\text{H}_2\text{O}$	16.56	28.99	$\text{C}_6\text{H}_5\text{ONa} \cdot 3\text{H}_2\text{O}$
26.56	0.08	$\text{C}_6\text{H}_5\text{ONa} \cdot 3\text{H}_2\text{O}$	16.62	31.75	"
23.69	0.61	"	16.47	36.54	$\text{C}_6\text{H}_5\text{ONa} \cdot 2\text{C}_6\text{H}_5\text{OH}$
19.47	2.06	"	14.25	44.81	"
18.19	5.18	"	13.17	48.31	"
17.61	6.91	"	10.74	57.47	"
16.52	10.08	"	7.88	67.03	"
15.27	13.44	"	5.68	73.37	$\text{C}_6\text{H}_5\text{OH}$
15.21	14.61	"	3.32	73.98	"
15.89	19.67	"	0.0	74.27	"
15.98	23.24	"			

SODIUM GLUCONATE $\text{NaC}_6\text{H}_{11}\text{O}_7$.

100 gms. sat. solution of Sodium Gluconate in Water contain 46.1

SODIUM Nitro PHENOLATE (*p*) $C_6H_4NO_2.ONa.2H_2O$.

SOLUBILITY OF SODIUM PARA NITRO PHENOLATE IN AQUEOUS ALCOHOL AT
(Fischer, 1914, 1918.)

Saturation was secured by means of constant agitation in a thermostat.
compound also crystallized with 4 H_2O but in all concentrations of alcohol a
15 per cent the solid phase was $C_6H_4NO_2.O Na.2 H_2O$.

Vol. % C_2H_5OH .	Gms. p $C_6H_4NO_2.ONa$ per 100 cc. sat. sol.	Vol. % C_2H_5OH .	Gms. p $C_6H_4NO_2.ONa$ per 100 cc. sat. sol.	Vol. % C_2H_5OH .	Gms. p $C_6H_4NO_2.ONa$ per 100 cc. sat. sol.
0.....	5.640	40.....	5.344	75.....	3.28
10.....	5.168	45.....	5.313	80.....	2.75
15.....	5.019	50.....	5.200	85.....	2.04
20.....	5.007	55.....	5.039	90.....	1.49
25.....	5.088	60.....	4.749	95.....	1.25
30.....	5.156	65.....	4.378	100.....	4.41
35.....	5.281	70.....	3.895		

SODIUM Chloro Nitro PHENOLATE $C_6H_3(4)Cl(2)NO_2(1)ONa.H_2O$.

SOLUBILITY OF CHLORO NITRO PHENOLATE IN AQUEOUS ALCOHOL AT 25°
(Fischer, 1914, 1918.)

Vol. % C_2H_5OH .	Gms. $C_6H_3Cl(NO_2)_2ONa$ per 100 cc. sat. sol.	Solid Phase.	Vol. % C_2H_5OH .	Gms. $C_6H_3ClNO_2.ONa$ per 100 cc. sat. sol.	Solid Phase
0....	2.702	$C_6H_3ClNO_2.ONa.H_2O$	55....	2.564*	
10....	2.374	"	60....	3.146	
15....	2.346	"	65....	3.110	$C_6H_3ClNO_2$
20....	2.314	"	70....	2.604	"
25....	2.404	"	75....	2.307	"
30....	2.576	"	80....	1.860	"
35....	2.708	"	85....	1.293	"
40....	2.990	"	90....	0.870	"
45....	3.190	"	95....	0.616	"
50....	3.668	$>+C_6H_3ClNO_2ONa$	100....	0.680	"

* Gradual dehydration by the alcohol occurs here.

SODIUM Dinitro PHENOLATE $C_6H_3(2,4)(NO_2)_2(1)ONa.H_2O$.

SOLUBILITY OF SODIUM DINITRO PHENOLATE AT 25° IN :
(Fischer, 1914, 1918.)

Aqueous Ethyl Alcohol.			Aqueous Methyl Alcohol.			Aqueous Ace		
Vol. % C_2H_5OH .	Gms. $C_6H_3(NO_2)_2ONa.H_2O$ per 100 cc. sat. sol.	Vol. % C_2H_5OH .	Gms. $C_6H_3(NO_2)_2ONa.H_2O$ per 100 cc. sat. sol.	Vol. % CH_3OH .	Gms. $C_6H_3(NO_2)_2ONa.H_2O$ per 100 cc. sat. sol.	Vol. % $CO CH_3$.	Gms. $C_6H_3(NO_2)_2ONa.H_2O$ per 100 cc. sat. sol.	Gms. $C_6H_3(NO_2)_2ONa.H_2O$ per 100 cc. sat. sol.
0....	4.461	55....	3.392	0....	4.461	0....	4.4	
10....	3.516	60....	3.214	10....	3.686	10....	4.8	
15....	3.246	65....	2.976	20....	3.196	20....	5.4	
20....	3.188	70....	2.630	30....	2.950	30....	6.0	
25....	3.090	75....	2.174	40....	2.854	40....	6.8	
30....	3.148	80....	1.798	50....	2.824	50....	7.4	
35....	3.260	85....	1.258	60....	2.792	60....	7.7	
40....	3.386	90....	0.818	70....	2.672	70....	7.50	
45....	3.440	95....	0.566	80....	2.518	80....	6.5	
50....	3.470	100....	2.671	90....	2.475	90....	4.3	
				100....	4.651	100....	1.0	

SODIUM p NITROPHENOL $C_6H_4.ONa(1).NO_2(4)$.

SOLUBILITY IN WATER AND IN AQUEOUS NORMAL SOLUTIONS OF NON-ELECTROLYTES.

(Goldschmidt, 1895.)

t°.	Gms. $C_6H_4.ONa(1).NO_2(4)$ per 100 Gms. Solution in:							
	Water.	Alcohol.	Urea.	Glycerine.	Acetone.	Propionitril.	Acetonitril.	Urethane.
23.7	5.597	5.615	6.244	6.188	6.225	6.257	6.065	6.520
28.6	6.721	6.874	7.489	7.440	7.498	7.571	7.328	7.889
30.6	7.256	...	...	...	...	...	...	...
33.6	8.125	8.318	9.000	9.025	9.025	9.066	8.886	9.507
35.9	8.851	...	...	...	...	...	...	...
36.1	8.883	...	9.683	9.688	9.665	9.911	9.667	10.248
40.2	9.881	10.147	10.666	10.777	10.695	10.905	10.667	11.379
45.2	11.235	11.513	12.068	12.229	...	...	...	12.869
50.1	12.730	13.133	13.555	13.785	...	...	...	...

The solid phase is $C_6H_4.ONa.NO_2.4H_2O$ below 36°, and $C_6H_4.ONa.NO_2.2H_2O$ above 36° in each case.

SODIUM PICRATE $C_6H_2(NO_2)_3.ONa.H_2O$.

SOLUBILITY IN WATER AND IN AQUEOUS SOLUTIONS AT 25°.

(Fisher and Miloszewski, 1910.)

100 cc. H_2O dissolve 4.247 gms. $C_6H_2(NO_2)_3.ONa.H_2O$ at 25°.

Solubility in Aq. Solution of:	Gms. $C_6H_2(NO_2)_3.ONa.H_2O$ per 100 cc. Aq. Solution of Normality:							
	0.01.	0.02.	0.04.	0.066.	0.10.	0.25.	0.5.	1.
Na_2CO_3	4.159	4.044	3.807	3.434	3.187	2.017	1.120	0.611
$NaCl$	4.189	3.956	3.677	3.335	3.021	1.678	0.846	0.410
Na_2SO_4	4.246	4.102	3.879	3.651	3.195	2.053	1.156	0.552
Na_3PO_4	4.235	4.051	3.814	3.562	3.225	2.219	1.329	0.705
$NaOH$	4.192	4.048	3.715	3.339	2.941	1.781	0.921	0.371
$NaNO_3$	4.154	4.029	3.710	3.363	3.041	1.932	0.943	0.684
$NaBr$	4.190	4.117	3.770	3.384	3.024	1.777	0.912	0.499

Data for the solubility of sodium picrate and the sodium salts of other nitrophenols in aqueous alcohol and acetone solutions at 25° are given by Fisher (1914).

SOLUBILITY OF SODIUM PICRATE IN AQUEOUS SOLUTIONS OF ETHYL ALCOHOL.

(Fischer, 1914, 1918.)

At 0° the mixtures were stirred in a vessel which was cooled by melting ice. At 25° the mixtures were constantly agitated in a thermostat. The dissolved picrate was determined either by evaporating and weighing the residue or by a method of titration. The concentration of the aqueous alcohol mixtures was controlled by density determinations.

The solid phase in contact with the saturated solutions was $C_6H_2(NO_2)_3ONa.H_2O$ in all cases. Results at 0°.

Gms. $C_6H_2(NO_2)_3.ONa$ per 100 cc. sat. sol.		Gms. $C_6H_2(NO_2)_3.ONa$ per 100 cc. sat. sol.		Gms. $C_6H_2(NO_2)_3.ONa$ per 100 cc. sat. sol.		Gms. $C_6H_2(NO_2)_3.ONa$ per 100 cc. sat. sol.	
Vol. % C_2H_5OH .		Vol. % C_2H_5OH .		Vol. % C_2H_5OH .		Vol. % C_2H_5OH .	
0	1.824	45	1.042	0	4.280	50	3.409
5	1.426	50	1.125	5	3.741	55	3.313
10	1.169	55	1.293	10	3.326	60	3.245
15	0.964	60	1.277	15	3.017	65	3.047
20	0.816	80	0.884	20	2.816	70	2.777
25	0.721	90	0.547	25	2.744	75	2.465
30	0.718	95	0.449	30	2.789	80	1.948
35	0.755	100	2.683	35	2.994	85	1.537
40	0.843			40	3.145	90	1.247
				45	3.313	95	0.873
						100	4.438

SODIUM BENZOATE $(C_6H_5COO)Na$.

SOLUBILITY OF SODIUM BENZOATE IN WATER. (Sidgwick and Ewbank, 1922)

t°	Gms. C_6H_5COONa per 100 gms. sat. sol.	Solid Phase	t°	Gms. C_6H_5COONa per 100 gms. sat. sol.	Solid Phase
-2.02....	8.36	Ice	39.7....	39.2	C_6H_5CO
-4.85....	16.52	"	87.6....	41.96	"
-8.50....	26.01	"	97.0....	42.28	"
\pm 0.0....	38.52	C_6H_5COONa	133.0....	47.30	"
15.0....	38.59	"	151.3....	50.75	"
30.0....	38.60	"	186.0....	57.05	"
49.7....	38.70	"	204.5....	60.43	"

100 gms. 86.5 % glycerol ($d = 1.2326$) dissolve 31.5 gms. C_6H_5COONa at 2
 " 98.5 % " ($d = 1.2635$) " 98.5 "

(Helm, 1921.

SODIUM HydroxyBENZOATE (a) (Sodium Salicylate) $C_6H_4(OH)COONa$.

SOLUBILITY OF SODIUM ORTHO HYDROXY BENZOATE IN WATER.
[Sidgwick and Ewbank, 1922.]

t° .	Gms. $C_6H_5OH.COONa^{(a)}$ per 100 gms. sat. sol.	Solid Phase.	t°	Gms. $C_6H_5OH.COONa^{(a)}$ per 100 gms. sat. sol.	Solid Ph.
-0.77....	4.94	Ice	17.5....	11.40	$C_6H_5OH.COO$
-2.65....	13.15	"	20.0....	20.0	"
-5.04....	21.18 (unstable)	"	27.5....	35.1	$C_6H_5OH.CO$
-1.5....	20.06	$C_6H_5OH.COONa.C_6H_5O$	28.5....	59.32	"
+9.0....	29.61	"	44.0....	64.16	"
12.5....	35.03	"	47.0....	67.95	"
15.2....	40.38	"			

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SODIUM Hydroxy **BENZOATE** (m) $C_6H_5.OH.COONa$.

SOLUBILITY OF SODIUM META-HYDROXY BENZOATE IN WATER.
(Sidgwick and Ewbank, 1922.)

Gms.			Gms.		
$C_6H_5.OH$ (COONa) (m)			$C_6H_5.OH$ (COONa) (m)		
t°.	per 100 gms.	Solid Phase	t°.	per 100 gms.	Solid Phase
— 3.21....	14.68	Ice	— 10.0....	58.78	$C_6H_5.OH.CO$
— 8.85....	30.53	"	— 110.0....	64.64	"
— 17.52....	45.16	"	— 144.5....	69.24	"

SODIUM Hydroxy **BENZOATE** (*p*) $C_6H_4(OH)(COO)Na$.

SOLUBILITY OF SODIUM PARA HYDROXY BENZOATE IN WATER.
(Sidgwick and Ewbank, 1923.)

Gms.		Gms.			
t°.	$C_6H_5.OH.COONa.(p)$ per 100 gms. sat. sol.	Solid Phase	t°.	$C_6H_5.OH.COONa.(p)$ per 100 gms. sat. sol.	Solid Phase
-0.77...	5.075	Ice	36.5...	11.32	$C_6H_5.OH.COONa$
-2.07...	10.43	"	39.0...	11.61	" (m)
+7.0...	19.65	$C_6H_5.OH.COONa \cdot 5H_2O$	44.0...	11.61	$C_6H_5.OH.CO$
24.0...	31.47		107.5...	10.51	"
			163.0...	11.93	"

SODIUM BENZOATE C_6H_5COONa .

SOLUBILITY IN AQUEOUS ETHYL ALCOHOL AT 25°.
(Seidell, 1910.)

Wt. Per cent C_2H_5OH in Solvent.	d_{20} of Sat. Sol.	Gms. C_6H_5COONa per 100 Gms. Sat. Sol.	Wt. Per cent C_2H_5OH in Solvent.	d_{20} of Sat. Sol.	Gms. C_6H_5COONa per 100 Gms. Sat. Sol.
0	1.155	36	60	0.975	21.3
10	1.132	35.3	70	0.977	15.4
20	1.110	33.7	80	0.977	8.8
30	1.086	31.5	90	0.931	2.8
40	1.055	28.0	95	0.912	1.3
50	1.020	25.0	100	0.795	0.0

SODIUM BENZOATE

100 gms. Methyl Alcohol (CH_3OH) dissolve 8.22 gms. $\text{C}_6\text{H}_5\text{COONa}$ at 15° and 7.55 gms. at 66.2° (b.pt.) (Henstock, 1934.)

THE SYSTEM BENZOIC ACID, SODIUM BENZOATE AND WATER AT 14° .
(Landrien, 1920.)

The curve representing this system consists of three branches. The first branch corresponds to solutions saturated with benzoic acid. The second represents solutions saturated with the double salt, $\text{C}_6\text{H}_5\text{COONa} \cdot 2\text{C}_6\text{H}_5\text{COOH}$ and the third, solutions saturated with sodium benzoate. At the triple points the solutions have the following composition:

Gms. per 100 gms. sat. sol.		Solid Phase.
$\text{C}_6\text{H}_5\text{COOH}$	$\text{C}_6\text{H}_5\text{COONa}$	
1.25	35.3	$\text{C}_6\text{H}_5\text{COOH} + \text{C}_6\text{H}_5\text{COONa} \cdot 2\text{C}_6\text{H}_5\text{COOH}$
1.46	40.4	$\text{C}_6\text{H}_5\text{COONa} + \text{C}_6\text{H}_5\text{COOH}$

SOLUBILITY OF CAFFEINE IN AQUEOUS SOLUTIONS OF SODIUM BENZOATE AND VICE VERSA. (Pellini, 1910.)

Results at 25° .			Results at 40° .		
Gms. per 100	Gms. H_2O .	Solid Phase.	Gms. per 100	Gms. H_2O .	Solid Phase.
$\text{C}_8\text{H}_{10}\text{N}_4\text{O}_2$	$\text{C}_7\text{H}_5\text{O}_2\text{Na}$		$\text{C}_8\text{H}_{10}\text{N}_4\text{O}_2$	$\text{C}_7\text{H}_5\text{O}_2\text{Na}$	
2.13	0	$\text{CaH}_{10}\text{N}_4\text{O}_2 \cdot \text{H}_2\text{O}$	4.64	0	$\text{CaH}_{10}\text{N}_4\text{O}_2 \cdot \text{H}_2\text{O}$
8.32	6.67	"	31.43	25.31	"
38.10	45	"	56.82	69.68	"
51.74	76.75	" + $\text{C}_7\text{H}_5\text{O}_2\text{Na} \cdot \text{H}_2\text{O}$	57.90	74.64	" + $\text{C}_7\text{H}_5\text{O}_2\text{Na} \cdot \text{H}_2\text{O}$
46.27	76.68	$\text{C}_7\text{H}_5\text{O}_2\text{Na} \cdot \text{H}_2\text{O}$	55.98	74.02	$\text{C}_7\text{H}_5\text{O}_2\text{Na} \cdot \text{H}_2\text{O}$
24.79	69.56	"	18.31	67.97	"
9.47	62.97	"	0	59.82	"
0	61.17	"			

SOLUBILITY OF CAFFEINE IN AQUEOUS SOLUTIONS OF SODIUM SALICYLATE AND VICE VERSA. (Pellini and Amadori, 1912.)

Results at 25° .			Results at 40° .		
Gms. per 100	Gms. H_2O .	Solid Phase.	Gms. per 100	Gms. H_2O .	Solid Phase.
$\text{C}_8\text{H}_{10}\text{N}_4\text{O}_2$	$\text{C}_7\text{H}_5\text{O}_2\text{Na}$		$\text{C}_8\text{H}_{10}\text{N}_4\text{O}_2$	$\text{C}_7\text{H}_5\text{O}_2\text{Na}$	
2.13	0	$\text{CaH}_{10}\text{N}_4\text{O}_2 \cdot \text{H}_2\text{O}$	4.64	0	$\text{CaH}_{10}\text{N}_4\text{O}_2 \cdot \text{H}_2\text{O}$
38.36	30.76	"	59.49	37.47	"
55.23	47.31	"	86.49	62.47	"
74.32	68.81	"	95.94	69.15	"
16.78	124.96	$\text{C}_7\text{H}_5\text{O}_2\text{Na}$	26.93	131.52	$\text{C}_7\text{H}_5\text{O}_2\text{Na}$
13.22	121.27	"	10.75	124.35	"
9.03	120.54	"	0	119.66	"
0	115.43	"			

Data for the depression of the freezing-point of sodium salicylate solutions by caffeine and theobromine are also given.

SOLUBILITY OF SODIUM BENZOATE IN AQUEOUS SOLUTIONS OF CAFFEINE AND VICE VERSA.

(Chambon, Bouvier and Devron, 1937.)

Results at 37°			Results at 90°		
Gms. per 100	Gms. H_2O	Solid Phase	Gms. per 100	Gms. H_2O	Solid Phase
$\text{C}_8\text{H}_{10}\text{N}_4\text{O}_2$	$\text{C}_7\text{H}_5\text{O}_2\text{Na}$		$\text{C}_8\text{H}_{10}\text{N}_4\text{O}_2$	$\text{C}_7\text{H}_5\text{O}_2\text{Na}$	
0.0	59.9	$\text{C}_7\text{H}_5\text{O}_2\text{Na}$	0.0	76.5	$\text{C}_7\text{H}_5\text{O}_2\text{Na}$
58.1	78.92	" + $\text{C}_8\text{H}_{10}\text{N}_4\text{O}_2$	93.2	99.4	" + $\text{C}_8\text{H}_{10}\text{N}_4\text{O}_2$
11.85	7.25	$\text{C}_8\text{H}_{10}\text{N}_4\text{O}_2$	64.0	7.4	$\text{C}_8\text{H}_{10}\text{N}_4\text{O}_2$
3.85	0.0	"	83.5	0.0	"

SODIUM SALICYLATE $C_6H_4OH.COONa$.See also Sodium α Hydroxy Benzoate.**SOLUBILITY IN AQUEOUS ETHYL ALCOHOL AT 25°.** (Seidell, 1909, 1910.)

Wt. Per cent C_2H_5OH in Solvent.	d_{25} of Sat. Sol.	Gms. C_6H_4OH - $COONa$ per 100 Gms. Sat. Sol.	Wt. Per cent C_2H_5OH in Solvent.	d_{25} of Sat. Sol.	Gms. C_6H_4OH - $COONa$ per 100 Gms. Sat. Sol.
0	1.256	53.56	60	1.066	38.40
10	1.235	52.10	70	1.016	33
20	1.205	50.20	80	0.957	25
30	1.176	48	90	0.885	15
40	1.142	45.50	92.3	0.864	12
50	1.106	42.20	100	0.805	3.82

100 gms. sat. solution in water contain 51.8 gms. $C_6H_4OH.COONa$ at 15° and d_{15} of the sat. sol. is 1.249. (Greenish and Smith, 1901.)

100 gms. propyl alcohol dissolve 1.16 gms. $C_6H_4OH.COONa$ at ord. temp. (Schlamp, 189.)

Sodium salicylate distributes itself between olive oil and water at 15° in the ratio of 0.156 gm. $C_6H_4OH.COONa$ per 100 cc. oil layer and 1.444 gms. per 100 cc. aqueous layer. (Harrass, 190.)

100 gms. sat. solution of Sodium Salicylate in U.S.P. Alcohol ($d_{15} = 0.8176 = 92$ Wt. % C_2H_5OH) contain 11.74 gms. $C_6H_4OH.COONa$ at 25°. (Schnellbach, 1929.)

100 gms. Methyl Alcohol (CH_3OH) dissolve 26.28 gms. $C_6H_4OH.COONa$ at 15° and 34.73 gms. at 67.2°. (b.pt.) (Henstock, 1934.)

CH SODIUM Diethyl BARBITURATE $Na(C_4H_5O_2N_2)$.**SOLUBILITY IN WATER.**

(Puckner and Hilpert, 1909.)

Gms. Salt per 100 Gms. Sat. Sol.	t°.	5°	15°	25°	91°
		6.08	10.87	17.18	32.50

100 gms. U.S.P. Alcohol ($d_{25} = 0.8063 = 93.6$ Wt. % C_2H_5OH) dissolve 0.313 gm. $Na(C_4H_5O_2N_2)$ ("Sodium Barbitol") at 25°. (Schnellbach and Rosin, 1931.)

SODIUM MANDELATE $NaC_8H_7O_3$ (Racemic).**EQUILIBRIUM IN THE SYSTEM RACEMIC SODIUM MANDELATE, RACEMIC MANDELIC ACID AND WATER AT 25°.**

(Rosa and Morrison, 1933.)

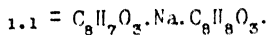
Gms. per 100 gms. sat. sol. $C_8H_8O_3$	Gms. per 100 gms. sat. sol. $C_8H_7O_3Na$	Solid Phase	Gms. per 100 gms. sat. sol. $C_8H_8O_3$	Gms. per 100 gms. sat. sol. $C_8H_7O_3Na$	Solid Phase
16.9	0.0	$C_8H_8O_3$	7.8	6.4	1.1
17.7	1.6	"	6.3	6.9	"
18.9	2.9	"	4.0	8.3	"
19.7	3.7	" + 3.1	3.1	9.2	"
17.6	3.7	3.1	2.0	10.9	"
15.2	3.9	"	1.5	12.5	"
13.7	4.5	"	0.9	15.8	"
13.0	4.8	"	0.8	16.6	"
12.4	4.9	"	0.7	17.1	"
10.9	5.5	"	0.5	22.3	"
10.4	5.7	1.1	0.4	23.7	"
9.2	6.0	"	0.4	24.5	"
			0.3	30.6	"

3.1 = $3C_8H_8O_3.C_8H_7O_3Na$; 1.1 = $C_8H_7O_3Na.C_8H_8O_3$.

SODIUM MANDELATE $\text{NaC}_8\text{H}_7\text{O}_3$ (Laevo)EQUILIBRIUM IN THE SYSTEM LAEVO SODIUM MANDELATE, LAEVO
MANDELIC ACID AND WATER AT 25°.

(Ross, Morrison and Johnstone, 1937.)

Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase
$\text{C}_8\text{H}_8\text{O}_3$	$\text{C}_8\text{H}_7\text{O}_3\text{Na}$		$\text{C}_8\text{H}_8\text{O}_3$	$\text{C}_8\text{H}_7\text{O}_3\text{Na}$	
10.1	0.0	$\text{C}_8\text{H}_8\text{O}_3$	12.3	11.3	$\text{C}_8\text{H}_8\text{O}_3 + 1.1$
10.0	0.9	"	8.9	11.6	1.1
10.1	1.7	"	7.4	11.9	"
11.0	4.3	"	5.1	13.0	"
12.2	8.5	"	0.8	32.6	"

SODIUM PHTHALATE $2\text{Na}_2\text{C}_8\text{H}_4\text{O}_4 \cdot 7\text{H}_2\text{O}$.

EQUILIBRIUM IN THE SYSTEM SODIUM PHTHALATE, PHTHALIC ACID AND WATER.

(Smith and Sturm, 1933.)

Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase
$\text{C}_8\text{H}_6\text{O}_4$	$\text{C}_8\text{H}_4\text{O}_4\text{Na}_2$		$\text{C}_8\text{H}_6\text{O}_4$	$\text{C}_8\text{H}_4\text{O}_4\text{Na}_2$	

Results at 0°			Results at 35°		
0.0	40.73	$2\text{Na}_2\text{C}_8\text{H}_4\text{O}_4 \cdot 7\text{H}_2\text{O}$	0.0	45.66	$2\text{Na}_2\text{C}_8\text{H}_4\text{O}_4 \cdot 7\text{H}_2\text{O}$
0.16	40.74	" + $2\text{NaHC}_8\text{H}_4\text{O}_4 \cdot \text{H}_2\text{O}$	0.34	45.90	" + $2\text{NaHC}_8\text{H}_4\text{O}_4 \cdot \text{H}_2\text{O}$
0.16	36.20	$2\text{NaHC}_8\text{H}_4\text{O}_4 \cdot \text{H}_2\text{O}$	0.39	42.03	$2\text{NaHC}_8\text{H}_4\text{O}_4 \cdot \text{H}_2\text{O}$
0.28	27.20	"	0.51	31.81	"
0.50	19.26	"	1.08	20.84	"
1.63	6.60	"	1.23	19.26	"
2.70	3.88	" + $\text{C}_8\text{H}_6\text{O}_4$	3.27	9.56	"
1.68	1.93	$\text{C}_8\text{H}_6\text{O}_4$	4.72	6.78	"
0.30	0.0	"	5.32	6.60	"
			5.83	6.38	" + $\text{C}_8\text{H}_6\text{O}_4$
			5.51	5.88	$\text{C}_8\text{H}_6\text{O}_4$
			4.31	4.15	"
			1.93	1.07	"
			0.98	0.0	"

Results at 25°			Results at 50°		
0.0	43.81	$2\text{Na}_2\text{C}_8\text{H}_4\text{O}_4 \cdot 7\text{H}_2\text{O}$	0.0	50.60	$2\text{Na}_2\text{C}_8\text{H}_4\text{O}_4 \cdot 7\text{H}_2\text{O}$
0.28	41.04	" + $2\text{NaHC}_8\text{H}_4\text{O}_4 \cdot \text{H}_2\text{O}$	0.55	50.93	" + $2\text{NaHC}_8\text{H}_4\text{O}_4 \cdot \text{H}_2\text{O}$
0.28	42.46	$2\text{NaHC}_8\text{H}_4\text{O}_4 \cdot \text{H}_2\text{O}$	0.60	44.58	$2\text{NaHC}_8\text{H}_4\text{O}_4 \cdot \text{H}_2\text{O}$
0.31	41.30	"	0.86	33.75	"
0.31	37.20	"	1.68	22.20	"
0.33	35.78	"	4.13	12.17	"
0.48	29.22	"	5.91	9.19	"
0.56	26.04	"	6.82	8.47	"
0.82	20.17	"	8.69	8.35	" + $\text{C}_8\text{H}_6\text{O}_4$
1.41	13.87	"	5.27	4.30	$\text{C}_8\text{H}_6\text{O}_4$
1.85	10.85	"	1.75	0.0	"
2.82	7.58	"			
4.48	5.52	" + $\text{C}_8\text{H}_6\text{O}_4$			
3.51	3.94	$\text{C}_8\text{H}_6\text{O}_4$			
1.98	1.67	"			
0.68	0.0	"			

SODIUM PHTHALATE $2\text{Na}_2\text{C}_8\text{H}_4\text{O}_4 \cdot 7\text{H}_2\text{O}$.EQUILIBRIUM IN THE SYSTEM SODIUM PHTHALATE, SODIUM SULFATE AND WATER.
(Foote and Smith, 1924.)

Gms. per 100 gms. sat. sol.		Solid Phase.	Gms. per 100 gms. sat. sol.		Solid Phase.
$\text{Na}_2\text{C}_8\text{H}_4\text{O}_4$	Na_2SO_4		$\text{Na}_2\text{C}_8\text{H}_4\text{O}_4$	Na_2SO_4	
Results at 0°.					
40.56	0.0	$2\text{Na}_2\text{C}_8\text{H}_4\text{O}_4 \cdot 7\text{H}_2\text{O}$	27.52	7.59	$\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}$
40.20	0.56	" $\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}$	21.09	9.67	"
25.83	0.63	$\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}$	17.47	11.12	"
0.0	4.48	"	12.35	13.61	"
Results at 23°.					
43.79	0.0	$2\text{Na}_2\text{C}_8\text{H}_4\text{O}_4 \cdot 7\text{H}_2\text{O}$	10.14	14.78	"
40.63	3.52	"	7.39	16.53	"
39.92	4.57	" Na_2SO_4	6.18	17.35	"
37.94	5.48	Na_2SO_4	0.0	21.75	"
Results at 38°.					
30.88	8.69	"	46.06	0.0	$\text{Na}_2\text{C}_8\text{H}_4\text{O}_4 \cdot 7\text{H}_2\text{O}$
24.62	12.62*	"	43.25	3.25	" + Na_2SO_4
13.67	20.91*	"	38.64	9.67	Na_2SO_4
35.40	6.29	" $\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}$	11.24	12.38	"
34.06	6.39	$\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}$	0.0	31.10	"
* Determinated with respect to $\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}$					

* Supersaturated with respect to $\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}$.

CH

SODIUM CINNAMATE $\text{C}_6\text{H}_5\text{CH}=\text{CHCOONa}$.100 gms. H_2O dissolve 0.1 gms. sodium cinnamate at 15.20°.

100 cc. 90% alcohol dissolve 0.625 gm. at 15.20°. (Squire and Caines, 1902)

SODIUM GUANYLATE $\text{C}_{10}\text{H}_{13}\text{N}_5\text{O}_7\text{P}$ SOLUBILITY OF SODIUM GUANYLATE IN AQUEOUS SOLUTIONS OF SODIUM CHLORIDE AND OF SODIUM CHLORIDE AT 20°.
(Foulgen and Rosenheck, 1923.)

Warm solutions of sodium guanylate were prepared and these cooled a slight excess of the salt separated. They were then allowed to stand mar in a thermostat at 20°. The nitrogen in a given volume of the saturation was determined and from this the amount of guanylate present was calculated.

Normality of aq. salt solution.	Results for aq. CH_3COONa solutions.			Results for a NaCl solution.		
	Gms. per 100 cc. solution			Gms. per 100 cc. sol.		
	CH_3COONa	N	Na guanylate	NaCl	N	Na guanylate
0.0 (= H_2O)	0.0		2.89	0.0		2.89
0.0625	0.86	0.42	2.45	0.37	0.49	2.45
0.25	3.45	0.315	1.81	1.46	0.29	1.81
1.00	13.81	0.08	0.48	5.84	0.12	0.48
2.00	27.22	0.04	0.20			
4.00	54.44	0.020	0.11	21.4	0.035	0.11
		0.01	0.15		0.048	0.15

The results are considered of interest in showing the quantitative limit of the sodium acetate method for the determination of guanylic acid.

SODIUM CAMPHORATES

SOLUBILITY IN AQUEOUS *d* CAMPHORIC ACID SOLUTIONS AT 13.5°-16°.
(Jungfleisch and Landrieu, 1914.)

Gms. per 100 Gms. Sat. Sol.		Solid Phase.	Gms. per 100 Gms. Sat. Sol.		Solid Phase.
$C_{10}H_{16}O_4$	$C_{10}H_{14}O_4Na_2$		$C_{10}H_{16}O_4$	$C_{10}H_{14}O_4Na_2$	
0.621	0	$C_{10}H_{16}O_4$	2.87	25.62	$C_{10}H_{14}O_4Na_2 \cdot C_{10}H_{16}O_4 \cdot 2H_2O$
2.03	4.19	"	2.89	27.41	"
2.87	8.32	"	2.74	30.69	"
3.03	10.05	"	2.63	32.75	"
2.97	7.80	" + $C_{10}H_{14}O_4Na_2 \cdot C_{10}H_{16}O_4 \cdot 2H_2O$	2.29	40.10	$C_{10}H_{14}O_4Na_2 \cdot H_2O$ (or $\frac{1}{2}H_2O$)
2.87	9.06	$C_{10}H_{14}O_4Na_2 \cdot C_{10}H_{16}O_4 \cdot 2H_2O$	2.17	40.54	"
2.94	10.46	"	1.06	47.04	"
2.68	14.99	"	0.88	49.60	$C_{10}H_{14}O_4Na_2 \cdot 3H_2O$
2.64	17.53	"	0	50.2	"

$C_{10}H_{16}O_4$ = Camphoric acid. $C_{10}H_{14}O_4Na_2 \cdot C_{10}H_{16}O_4 \cdot 2H_2O$ = Monosodium *d* tri-camphorate. $C_{10}H_{14}O_4Na_2 \cdot H_2O$ = Monosodium *d* camphorate. $C_{10}H_{14}O_4Na_2 \cdot 3H_2O$ = Disodium *d* camphorate (neutral).

(The mixtures were kept in a cellar at a nearly constant temperature and shaken from time to time. Additional determinations at 17°-23° are also given.)

SODIUM Benzene and Other SULFONATES

SOLUBILITY OF SODIUM BENZENE SULFONATE IN WATER AND IN
AQUEOUS SOLUTIONS OF SODIUM SULFATE.

(Rhodes, and Lewis, 1929.)

t°	Gms. $NaC_6H_5SO_3$ per 100 gms. sat. solution in:			Solid Phase
	Water	Aq. 5% Na_2SO_4	Aq. 10% Na_2SO_4	Aq. 20% Na_2SO_4
0	26.8	—	—	$NaC_6H_5SO_3 \cdot 2H_2O$
30	35.8	32.2	27.7	—
40	38.6	—	—	"
50	41.9	38.6	34.4	25.8
60	45.1	—	—	"
70	48.0	45.2	42.1	31.9
80	51.1	—	—	$NaC_6H_5SO_3 \cdot ?H_2O$
105	58.5	—	—	"

The hydrated salt is transformed to the anhydrous salt at 66.8°.

SOLUBILITY OF SODIUM BENZENE SULFONATE IN WATER.

(Hauslick, 1935.)

t°	Gm. Mols. $NaC_6H_5SO_3$ per 100 gms. H_2O	Solid Phase	t°	Gm. Mols. $NaC_6H_5SO_3$ per 100 gms. H_2O	Solid Phase
3	0.125	$NaC_6H_5SO_3 \cdot 2H_2O$	70	0.440	$NaC_6H_5SO_3 \cdot ?H_2O$
17	0.190	"	81	0.513	"
26	0.232	"	93	0.555	"
47	0.326	"	120	0.680	"
57	0.385	"			

SOLUBILITY OF SODIUM XYLENE SULFONATE, SODIUM CYMENE SULFONATE AND SODIUM α NAPHTHALENE SULFONATE, EACH SEPARATELY, IN WATER.
(Hauslick, 1936.)

Results for:

Na Xylene Sulfonate

t°	Gms. Mols. NaC ₆ H ₃ (CH ₃) ₂ SO ₃ per 100 gms. H ₂ O
3	0.090
26	0.337
41	0.513
56	0.673
60	0.720
80	0.925
115	1.300

Na Cymene Sulfonate

t°	Gms. Mols. NaC ₈ H ₇ CH ₃ (CH ₃) ₂ SO ₃ per 100 gms. H ₂ O
3	0.169
30	0.562
47	0.792
66	1.048
88	1.362
119	1.779

Na α Naphthalene Sulfonate

t°	Gms. Mols. NaC ₁₀ H ₇ SO ₃ per 100 gms. H ₂ O
2	0.044
25	0.074
37	0.089
59	0.145
78	0.241
90	0.357

SODIUM SULFONATES

SOLUBILITY IN WATER.

	Salt.	Formula.	t°.	Gms. Anhydrous Salt per 100 (Gms. H ₂ O).	Authority.
CH	Sodium:				
	2.5 Diiodobenzene Sulfonate	C ₆ H ₃ I ₂ SO ₃ Na	22.5	6.82	(Boyle, 1909.)
	3.4 " "	C ₆ H ₃ I ₂ SO ₃ Na.H ₂ O	22.5	3.47	"
	β Naphthalene Sulfonate	C ₁₀ H ₇ SO ₃ Na	23.9	0.04	(Fischer, 1906.)
	" "	"	25	5.87*	(Witt, 1915.)
	2 Phenathrene Sulfonate	C ₁₄ H ₉ SO ₃ Na.½H ₂ O	20	0.42	(Sandquist, 1912.)
	3 " "	C ₁₄ H ₉ SO ₃ Na.H ₂ O	20	1.1	"
	10 " "	C ₁₄ H ₉ SO ₃ Na.2H ₂ O	20	1.63	"
	Phenol Sulfonate	C ₆ H ₄ (OH)SO ₃ Na.2H ₂ O	15	14.7†	(Greenish & Smith, '01.)
	"	"	25	19.2‡	(Seidell, 1910.)
				* d ₂₀ = 1.079.	† d ₁₅ = 1.067.
				‡ d ₂₀ = 1.079	

SOLUBILITY OF SODIUM β NAPHTHALENE SULFONATE IN AQUEOUS HYDROCHLORIC ACID AT 23.9°. (Fischer 1906.)

Normality of Aq. HCl.	1.0 N.	2 N.	3 N.	5 N.
Gms. C ₁₀ H ₇ SO ₃ Na per 100 gms. Aq. HCl	6.47	5.35	4.13	2.42

SOLUBILITY OF SEVERAL SODIUM SULFONATES IN WATER.

Compound.	Formula.	t°.	Gms. anhydrous per 100 gms.
Sodium 10-Chloro 3 or 6 sulfonate.....	C ₁₀ H ₆ ClSO ₃ Na.H ₂ O	20	0.26
Sodium 2.6.8 Naphthylamine disulfonate....	C ₁₀ H ₆ (NH ₂) ₂ (SO ₃ Na) ₂	15	59.0
" 2.5.7 " "	"	15	72.2
" 2.6.8 " "	" acid salt C ₁₀ H ₆ (NH ₂) ₂ (SO ₃ H)Na	15	7.46
" 2.5.7 " "	" " "	15	7.91

(*) Sandquist, 1917. (†) Braunschweig.

SODIUM β Naphthalene SULFONATE C₁₀H₇SO₃Na.

Data (in the form of triangular diagrams) for the solubility of sodium β naphthyl sulfonate in aqueous solutions of sodium chloride and sodium sulfate at various temperatures between 25° and 65° are given by Cooke, 1921. In one case mentioned that 100 gms. of a sat. solution contain 8.47 gms. of the β salt 2.93 gms. Na Cl at 65°.

SOLUBILITY OF SODIUM PHENOL SULFONATE IN AQUEOUS ALCOHOL AT 25°.
(Seidell, 1910.)

Wt. Per cent C_2H_5OH in Solvent.	d_{25} of Sat. Sol.	Gms. $C_6H_4(OH)SO_3Na \cdot 2H_2O$ per 100 Gms. Sat. Sol.	Wt. Per cent C_2H_5OH in Solvent.	d_{25} of Sat. Sol.	Gms. $C_6H_4(OH)SO_3Na \cdot 2H_2O$ per 100 Gms. Sat. Sol.
0 ($= H_2O$)	1.079	19.38	60	0.919	7.5
10	1.054	17.4	70	0.886	5.1
20	1.030	15.5	80	0.852	2.9
30	1.004	13.6	90	0.820	1.1
40	0.977	11.7	95	0.810	0.8
50	0.950	9.7	100	0.800	1.5

In the 100 per cent C_2H_5OH solution, the solid phase, $C_6H_4(OH)SO_3Na \cdot 2H_2O$, became opaque.

100 gms. H_2O dissolve 18.25 gms. $C_6H_4(OH)SO_3Na \cdot 2H_2O$ at 14.8°, $d_{14.8}$ of sat. sol. = 1.0675. (Greenish and Smith, 1901.)

SOLUBILITY OF SODIUM BENZENE SULFONATE AND OF SODIUM
NAPHTHALENE SULFONATE, EACH SEPARATELY IN METHYL ALCOHOL.
(Henstock, 1934.)

Compound	Formula	t°	Gms. Anhydrous Compound per 100 gms. CH_3OH
Na Benzene Sulfonate	$NaC_6H_5SO_3 \cdot 2H_2O$	15	6.51
" " "	"	b.pt. (66.6°)	8.00
" Naphthalene "	$NaC_{10}H_7SO_3$	15	1.37
" " "	"	b.pt. (65.8°)	2.10

SOLUBILITY OF CHLORO BENZENE SULFONATES IN WATER.
(Ferrero and Bollinger, 1928.)

Compound	Formula	Gms. Compound per 100 cc. sat. sol. at:
		18° 98°
Na Benzene 1.3 Chloro Sulfonate	$NaC_6H_4ClSO_3$	4.37 45.0
" " 1.4 " "	"	1.79 40.0

SOLUBILITY OF SODIUM ANTHRAQUINONE SULFONATES IN WATER.
(Fierz-David, Krebsen and Anderau, 1927.)

Compound	Formula	t°	Gms. Anhydrous (?) compound per 100 cc. H_2O
Na Anthraquinone 1.5 Disulfonate	$Na_2C_{14}H_8O_2(SO_3Na)_4$	18	66
" " 1.8 " "	"	18	66
" " 1.6 " "	"	18	100
" " 1.5 Chloro Sulfonate	$NaC_{14}H_6O_2ClSO_3$	18	1.05
" " 1.8 " "	"	18	1.37
" " " "	"	100	1.43
" " -2- Sulfonate	$NaC_{14}H_8O_2SO_3 \cdot H_2O$	18	0.83
" " " "	"	100	21.0
" " 2.6 Disulfonate	$Na_2C_{14}H_6O_2(SO_3Na)_2$	18	2.90
" " " "	"	100	18.33
" " 2.7 " "	"	18	30.50

* Gms. per 100 gms. sat. solution.

SODIUM SULFONATES

SOLUBILITY OF SODIUM ALKYL SULFONATES IN WATER.

(Reed and Tartar, 1936.)

Compound	Formula	Gms. Compound per 100 gms.	
		25°	60°
Na <u>n</u> Octyl Sulfonate	$\text{NaCH}_3(\text{CH}_2)_6\text{CH}_2\text{SO}_3$	74.40	—
Na <u>n</u> Decyl "	$\text{NaCH}_3(\text{CH}_2)_8\text{CH}_2\text{SO}_3$	4.55	—
Na Lauryl "	$\text{NaCH}_3(\text{CH}_2)_{10}\text{CH}_2\text{SO}_3$	0.253	>48.0
Na Myristyl "	$\text{NaCH}_3(\text{CH}_2)_{12}\text{CH}_2\text{SO}_3$	0.041	38.8
Na Cetyl "	$\text{NaCH}_3(\text{CH}_2)_{14}\text{CH}_2\text{SO}_3$	0.0073	6.4
Na <u>n</u> Octa decyl "	$\text{NaCH}_3(\text{CH}_2)_{16}\text{CH}_2\text{SO}_3$	0.0010	0.1

SOLUBILITY OF SODIUM ALKYL SULFONATES IN WATER.

(Tartar and Wright, 1930.)

The following very careful determinations show that these salts increase in solubility very slowly up to a certain temperature and very sharply beyond this definite critical concentration. This phenomenon is explained in terms of the ionic micelle concept. It was also found by hydration experiments that each salt forms a hydrate containing 3.5 m of H_2O .

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The following results are in terms of the grams of salt (designated C_{10} , C_{12} , etc.) dissolved per 100 gms. H_2O .

C_{10} = Sodium Decyl Sulfonate, $\text{NaCH}_3(\text{CH}_2)_8\text{CH}_2\text{SO}_3$.
 C_{12} = " Dodecyl " " $(\text{CH}_2)_{10}$ "
 C_{14} = " Tetradecyl " " $(\text{CH}_2)_{12}$ "
 C_{16} = " Hexadecyl " " $(\text{CH}_2)_{14}$ "
 C_{18} = " Octadecyl " " $(\text{CH}_2)_{16}$

t°	C_{10}	t°	C_{12}	t°	C_{14}	t°	C_{16}	t°	C_{18}
15	0.733	20	0.134	25	0.040	37	0.013	47.5	0.0117
17	0.800	25	0.191	29	0.052	41	0.0205	54	0.0217
20	0.897	30	0.248	40	0.087	47.5	0.035	57	0.0270
23	1.04	32	0.277	41.7	0.139	48.25	0.0463	58	0.0362
24	1.22	34	0.360	43	0.270	49	0.056	59	0.0520
25	1.93	35	0.441	45	0.700	50	0.100	60	0.0820
27.38	6.43	36	0.950	46	1.38	51	0.151	61.5	0.177
29	11.02	37	1.78	47	2.20	55	0.88	65	0.90
31	18.70	38	2.97	48	3.28	56.5	1.60	67.01	2.00
32	23.68	40	6.54	49	5.08	58.0	2.60	69.05	5.60
34	36.70	41	9.60	50	8.20	60	6.00	70.23	11.5
36	53.5	43	18.20	51	12.3	61.96	11.55		
36.86	62.3	45	31.46	53	22.4	63.36	20.86		
		46.34	52.8	54	32.9				

SODIUM LAURATE $\text{NaCH}_3(\text{CH}_2)_{10}\text{COO}$.

EQUILIBRIUM IN THE SYSTEM SODIUM LAURATE AND WATER

(McBain, Brock, Vold and Vold, 1938.)

The determinations were made by the synthetic method which consists in observing the temperatures at which phase changes occur in systems of known composition. In the following table, t_1^0 , shows the upper temperature limits of the existence of liquid crystalline soap phases and t_2^0 , shows the upper temperature limits of the existence of crystalline soap.

t_1^0	t_2^0	Wt. percent $\text{Na}(\text{CH}_3)(\text{CH}_2)_{10}\text{COOH}$ in sat. sol.	t_1^0	t_2^0	Wt. percent $\text{Na}(\text{CH}_3)(\text{CH}_2)_{10}\text{COOH}$ in sat. sol.
—	24	2.17	145	51	43.44
—	28	3.53	149	55	46.75
—	32	5.20	139	57	49.39
—	38	10.89	141	59	51.12
—	42	28.77	153	60	51.29
—	42	32.69	182	61	53.21
85	44	35.09	237	62.5	58.40
100	44	36.80	247	66	60.89
142	50	42.50	290	76	71.16
144	51	43.63	310	226	100.00

The authors also give results for the system Sodium Laurate, Sodium Chloride and Water at temperatures between 60° and 250° .

Results for the four component system Sodium Laurate, Sodium Palmitate, Sodium Chloride and Water at 90° , for two constant ratios of sodium palmitate to sodium laurate, are given by McBain, Vold and Jameson, 1939.

Results for the system Lauric Acid, Sodium Hydroxide and Water at 25° are given by Bury and Owens, 1936.

Results in the form of a triangular diagram for the system Lauric Acid Phenol and Water at 25° are given by Jencic, 1934.

SOLUBILITY OF SODIUM LAURATE IN 80 TO 100 VOL. PERCENT ETHYL ALCOHOL.

(Ekwald and Mylius, 1929.)

t°	Gms. $\text{Na}(\text{CH}_3)(\text{CH}_2)_{10}\text{COO}$ per 100 cc of:		
	80 Vol. % $\text{C}_2\text{H}_5\text{OH}$	90 Vol. % $\text{C}_2\text{H}_5\text{OH}$	99.9 Vol. % $\text{C}_2\text{H}_5\text{OH}$
0	1.98	0.61	0.42
8	2.63	0.86	0.54
12.5	3.65 (13°)	1.01	0.67 (16°)
20	6.62	1.31 (19°)	0.74 (20.5°)

The authors also give the following results for the Solubility of Lauric Acid in Ethyl Alcohol.

t°	Gms. $\text{CH}_3(\text{CH}_2)_{10}\text{COOH}$ per 100 cc of:		
	80 Vol. % $\text{C}_2\text{H}_5\text{OH}$	90 Vol. % $\text{C}_2\text{H}_5\text{OH}$	99.9 Vol. % $\text{C}_2\text{H}_5\text{OH}$
0	5.26	14.17 (-1°)	20.84
8	9.15 (8°)	28.48	36.00
12	22.50 (14°)	38.65	48.36
16.5	48.30 (21°)	56.32	72.81

EQUILIBRIUM IN THE SYSTEM SODIUM PALMITATE AND WATER.
(McBain, Lazarus and Pitten, 1930.)

The determinations were made by the synthetic method. The column t_1^0 shows the temperature above which the system consists of a single isotropic phase; t_c^0 shows the temperature above which the soap is completely in solution and crystals have completely disappeared.

t_1^0	t_c^0	Gm. Equivalent $\text{NaCH}_3(\text{CH}_2)_{14}\text{COO}$ per 1000 gms. H_2O	t_1^0	t_c^0	Gm. Equivalent $\text{NaCH}_3(\text{CH}_2)_{14}\text{COO}$ per 1000 gms. H_2O
—	58	0.105	164	79.5	3.18
—	64	0.256	159	80	3.427
—	66.1	0.500	173	—	3.511
—	71.1	1.411	225	79.3	4.087
—	72.2	1.744	258.5	81.2	5.01
120	73.5	1.50	264.5	82	6.016
152	74.8	1.856	277.5	93	9.003
157.5	76.5	2.047	285	102	11.90
167	78	2.343	—	114	17.54
170	78.3	2.633	—	125	26.40
171	78	2.67	—	130	47.00
168.5	79	2.996	—	132	84.80
			290	134	100.00

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The authors also give similar results for the system Sodium Palmitate + Sodium Chloride + Water, from which the isotherms between 80° and 290° are constructed.

The complete equilibrium diagram of the system Sodium Palmitate + Sodium Chloride + Water at 90° , has been determined by Vold and Ferguson 1938, with greater precision than attempted for any other system composed of soap, inorganic electrolyte and water.

EQUILIBRIUM IN THE SYSTEM SODIUM PALMITATE AND PALMITIC ACID.
(McBain and Field, 1933.)

The previous determinations upon this system by Donnan and White, 1911, are incomplete and erroneous, resulting from imperfect separation of solid from liquid. The present results establish the existence of definite acid soaps of constant composition. The observed temperature t_c^0 is that at which the last trace of solid crystal disappears on heating and t_1 is the first temperature at which the homogeneous isotropic liquid becomes turbid or non-homogeneous on cooling.

t_c^0	Mol. fraction $\text{NaCH}_3(\text{CH}_2)_{14}\text{COO}$ in sat. sol.	t_c^0	Mol. fraction $\text{NaCH}_3(\text{CH}_2)_{14}\text{COO}$ in sat. sol.	t_c^0	Mol. fraction $\text{NaCH}_3(\text{CH}_2)_{14}\text{COO}$ in sat. sol.
62.8	0.0000	74.2 tr.pt.	0.2747	113.2	0.4673
59.2 Eutec.	—	77.5	0.3034	120.5	0.5010
60.7	0.0175	82.5	0.3335	127.8	0.5310
61.1	0.0364	85.1	0.3599	138.0	0.5709
65.2	0.0665	88.4	0.3850	147.8	0.6155
67.9	0.1119	90.0	0.3995	158 tr.pt.	—
70.0	0.1555	91.1 tr.pt.	—	$(t_1^0 = 168.5)$	0.6682
72.3	0.2074	97.8	0.4161	$(t_1^0 = 201.5)$	0.7188
73.6	0.2404	106.2	0.4395	216 $(t_1^0 = 316.0)$	1.000

The acid soaps which are formed have the composition $\text{NaCH}_3(\text{CH}_2)_{14}\text{COO}$, $\text{CH}_3(\text{CH}_2)_{14}\text{COOH}$ and $2\text{NaCH}_3(\text{CH}_2)_{14}\text{COO} \cdot \text{CH}_3(\text{CH}_2)_{14}\text{COOH}$. Further results upon the above system by Ekwall, 1933, confirm the existence of definite acid soaps but their compositions are given as $\text{NaCH}_3(\text{CH}_2)_{14}\text{COO}$, $\text{CH}_3(\text{CH}_2)_{14}\text{COOH}$ and $2\text{NaCH}_3(\text{CH}_2)_{14}\text{COO} \cdot \text{CH}_3(\text{CH}_2)_{14}\text{COOH}$.

SODIUM PALMITATE $\text{CH}_3(\text{CH}_2)_{14}\text{COONa}$.100 gms. sat. solution in H_2O contain 0.2 gm. sodium palmitate.

100 gms. sat. solution in 5% aq. bile salts contain 1 gm. sodium palmitate.

100 gms. sat. solution in 5% aq. bile salts + 1% lecithin contain 2.4 gms. sodium palmitate.

(Moore, Wilson and Hutchinson, 1909.)

SOLUBILITY OF SODIUM PALMITATE IN 70 TO 100 VOL. PERCENT ETHYL ALCOHOL.
(Exwall and Mylius, 1932.)

t°	Gms. $\text{CH}_3(\text{CH}_2)_{14}\text{COONa}$ per 100 cc :				
	70 Vol. % $\text{C}_2\text{H}_5\text{OH}$	80 Vol. % $\text{C}_2\text{H}_5\text{OH}$	90 Vol. % $\text{C}_2\text{H}_5\text{OH}$	96 Vol. % $\text{C}_2\text{H}_5\text{OH}$	99.9 Vol. % $\text{C}_2\text{H}_5\text{OH}$
-10	—	—	—	—	0.12
0	—	—	—	—	0.19
+ 5.5	1.16	—	—	—	—
8.0	—	1.16	0.67	0.40 (7.5°)	—
12.0	1.47	—	0.84 (14.°)	0.48 (12.5°)	—
18.0	2.16	1.85 (18.5°)	1.08 (19.5°)	0.63 (20°)	0.26 (17°)
23.0	3.21	3.20 (25°)	1.31 (23.5°)	0.70 (25°)	—

The authors also give the following results for the solubility of Palmitic Acid in Ethyl Alcohol.

t°	Gms. $\text{CH}_3(\text{CH}_2)_{14}\text{COOH}$ per 100 cc:					
	70 Vol. % $\text{C}_2\text{H}_5\text{OH}$	80 Vol. % $\text{C}_2\text{H}_5\text{OH}$	90 Vol. % $\text{C}_2\text{H}_5\text{OH}$	95 Vol. % $\text{C}_2\text{H}_5\text{OH}$	96 Vol. % $\text{C}_2\text{H}_5\text{OH}$	99.9 Vol. % $\text{C}_2\text{H}_5\text{OH}$
-10	—	—	—	—	—	0.61
0	—	—	—	—	—	1.56
+ 7	0.09	0.24 (6.5°)	0.82 (6°)	1.38	1.80 (8°)	—
12	0.14 (12.5°)	0.47 (13°)	1.12	1.95	2.21	—
19	0.32 (19.5°)	0.76	—	3.09 (16°)	4.60	5.53 (17°)
20	—	—	2.48	3.97	4.74	—
25	0.48 (24.5°)	1.45	—	—	—	—

SODIUM OLEATE $\text{C}_{18}\text{H}_{33}\text{O}_2\text{Na}$.**SOLUBILITY IN WATER AND AQUEOUS BILE SALTS.**

(Moore, Wilson and Hutchinson, 1909.)

Solvent.	Gms. Oleate per 100 Gms. Sat. Sol.
Water	5
Aq. 5% Bile Salts	7.6
Aq. 5% Bile Salts + 1% Lecithin	11.6

EQUILIBRIUM IN THE SYSTEM SODIUM OLEATE, PHENOL AND WATER AT 25°.
(Woodman, 1933.)

The determinations were made by titrating one component into a mixture of the other two until homogeneity or heterogeneity resulted.

Gms. per 100 gms. sat. sol.		Gms. per 100 gms. sat. sol.		Gms. per 100 gms. sat. sol.	
$\text{NaC}_{18}\text{H}_{33}\text{O}_2$	$\text{C}_6\text{H}_5\text{OH}$	$\text{NaC}_{18}\text{H}_{33}\text{O}_2$	$\text{C}_6\text{H}_5\text{OH}$	$\text{NaC}_{18}\text{H}_{33}\text{O}_2$	$\text{C}_6\text{H}_5\text{OH}$
0.0	8.27	10.45	0.0	16.91	48.4
0.09	8.67	12.62	2.14	29.29	59.2
0.23	9.94	13.71	4.60	20.37	69.1
0.48	12.19	14.61	7.39	15.68	76.7
1.72	16.96	17.22	11.48	13.24	78.3
1.80	38.16	21.39	14.36	6.27	87.2
2.04	45.11	25.87	16.24	0.0	94.7
2.25	57.54	30.85	21.48	2.09	92.1
1.50	64.62	36.57	27.99	3.08	91.6
1.11	65.88	39.60	29.34	9.44	86.0
0.80	67.36	43.75	33.88	11.29	83.4
0.72	68.04	43.57	34.94	12.57	81.5
0.52	68.36	44.25	35.16	13.52	81.9
0.0	70.34				

Similar results are given for the remaining ternary mixtures in the quaternary system, Sodium Oleate, Phenol, Toluene and Water and are of Practical value in the preparation of mixtures used for spraying.

EQUILIBRIUM IN THE SYSTEMS CRESOLS, SODIUM OLEATE AND WATER
(Bailey, 1923.)

Especial attention was given to the purification of the sodium oleate. determinations were made by the synthetic method.

Ortho Cresol + Sodium Oleate + Water at 20°.		Meta Cresol + Sodium Oleate + Water at 20°.		Para Cresol + Sodium Oleate + Water at 20°.	
Gms. per 100 gms. sat. sol.		Gms. per 100 gms. sat. sol.		Gms. per 100 gms. sat. sol.	
Cresol.	Oleate.	Cresol.	Oleate.	Cresol.	Oleate.
2.8	—	2.4	—	3.0	—
7.5	2.3	5.2	1.2	6.6	1.3
10.5	3.7	11.0	1.5	10.5	3.6
31.3	8.5	16.0	5.3	13.5	5.1
49.5	8.5	23.6	7.2	30.7	6.2
67.3	7.4	36.4	9.1	38.6	8.6
75.5	5.6	42.6	11.0	51.4	10.2
80.6	3.5	45.1	11.7	63.4	9.2
84.0	1.3	52.8	14.1	71.0	6.6
85.1	0.7	61.6	12.2	79.6	2.2
85.7	0.4	71.4	8.4	82.0	0.9
86.0	0.3	81.2	4.7	82.7	0.5
86.4	—	84.9	1.9	84.4	—
		87.2	—		

Results for equilibrium in the ternary systems and quaternary systems possible with the four components, sodium oleate, sodium chloride, ethyl acetate and water at 25° are given by Smith, 1932.)

SODIUM Salts of PHENOLPHTHALEIN

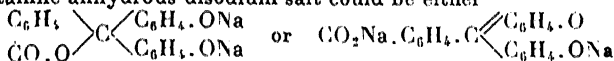
NATRIUM Na

EQUILIBRIUM IN THE SYSTEM SODIUM OXIDE, PHENOLPHTHALEIN ANHYDRIDE AND WATER AT 23°. (Bassett and Halton, 1923.)

Saturation was secured by constant rotation in a thermostat for 3 days. Both the solutions and the solid phases were analyzed. The compositions of the latter were established by the "rest method".

Gms. per 100 gms. sat. sol.			Gms. per 100 gms. sat. sol.		
Phenolphthalein			Phenolphthalein		
Na ₂ O.	anhydride.	Solid Phase.	Na ₂ O.	anhydride.	Solid Phase.
0.58	2.90	Phenolphthalein	10.24	31.00	Tri sodium salt 14 H ₂ O
2.71	13.74	"	10.37	27.89	"
4.25	22.43	"	11.34	25.03	"
6.11	31.96	"	12.69	23.25	"
6.95	36.06	Mono sodium salt+8H ₂ O	13.73	20.51	Tri sodium salt 13 H ₂ O
7.48	37.73	"	14.29	16.91	"
8.32	41.16	"	17.48	10.35	"
6.78	33.34	Mono sodium salt+4H ₂ O	19.8	9.12	Tri sodium salt 12 H ₂ O
9.31	37.36	"	20.32	4.28	"
9.88	41.45	"	23.46	1.37	"
10.06	44.06	"	25.42	0.86	"
11.00	45.55	Disodium salt, anhydrous	27.01	0.11	Tri sodium salt 6 H ₂ O
12.31	40.16	"	28.03	0.0	"
11.67	37.79	Di sodium salt 4 H ₂ O	30.74	0.0	"
11.98	34.78	"	37.41	0.23	"
9.97	38.42	Di sodium salt 8 H ₂ O	39.88	0.0	" +NaOH, H ₂ O
10.17	33.72	"			

The crystalline anhydrous disodium salt could be either



Since it is colorless it must be regarded as the diphenolic salt. The two hydrated forms of the disodium salt also have the phenolic structure. For the trisodium salt there is only one possible structure, namely, $\text{CO}_2\text{Na} \cdot \text{C}_6\text{H}_4 \cdot \text{C}(\text{C}_6\text{H}_4\text{ONa})_2 \cdot \text{OH}$, but two mono sodium salts are possible. They are $\text{CO}_2\text{Na} \cdot \text{C}_6\text{H}_4 \cdot \text{C}(\text{C}_6\text{H}_4\text{OH})_2 \cdot \text{OH}$

and $\begin{array}{c} \text{C}_6\text{H}_5 \\ \diagdown \\ \text{CO}_2\text{O} \end{array} \text{C} \begin{array}{c} \diagup \\ \text{C}_6\text{H}_4\text{ONa} \end{array}$ and $\begin{array}{c} \text{C}_6\text{H}_5 \\ \diagdown \\ \text{CO}_2\text{O} \end{array} \text{C} \begin{array}{c} \diagup \\ \text{C}_6\text{H}_4\text{OH} \end{array}$. It is probable that the solid hydrated mono sodium salts, which have been obtained in the present investigation, have the phenolic structure shown by the latter formula.

SODIUM CYANIDE $\text{NaCN} \cdot 2\text{H}_2\text{O}$.

SOLUBILITY OF SODIUM CYANIDE IN WATER.

(Frost, 1926.)

t°	Gms. NaCN per 100 gms. sat. solution	Solid Phase	t°	Gms. NaCN per 100 gms. sat. solution	Solid Phase
-4.0	5.50	Ice	-14.8	26.5	$\text{NaCN} \cdot 2\text{H}_2\text{O}$
-9.2	11.03	"	-7.6	27.9	"
-12.5	13.90	"	-4.0	28.9	"
-15.2	16.01	"	+10.0	32.5	"
-19.5	19.11	"	15.0	34.2	"
-23.4	21.23	"	20.4	37.02	"
-26.4	23.46	" + $\text{NaCN} \cdot 2\text{H}_2\text{O}$	25.4	39.1	"
-21.4	24.84	$\text{NaCN} \cdot 2\text{H}_2\text{O}$	29.5	41.56	"
-18.1	25.90	"	34.0	44.82	"
			35.0	45.0	NaCN

CN

SOLUBILITY OF SODIUM CYANIDE IN AQUEOUS SOLUTIONS OF SODIUM HYDROXIDE.
(Kirejew and Wagraskaja, 1938.)

Results at 0°			Results at 25°			Results at 40°		
Gms. per liter sat. sol.		d. of sat. sol.	Gms. per liter sat. sol.		d. of sat. sol.	Gms. per liter sat. sol.		d. of sat. sol.
NaOH	NaCN		NaOH	NaCN		NaOH	NaCN	
10	370	1.186	45	490	—	10	530	—
40	349	1.293	125	430	1.265	35	505	—
140	300	—	140	417	—	90	460	—
160	280	—	178	388	—	110	445	—
		1.332	210	365	—	160	400	—
		1.348	290	305	1.319	235	370	—
		—	420	220	—	290	305	—
		—	520	160	—	370	255	—

100 gms. Methyl Alcohol (CH_3OH) dissolve 6.44 gms. anhydrous NaCN at 15° and 4.10 gms. at 67.4° (b.pt.). (Henstock, 1934.)

Data for equilibrium in the system Sodium Cyanide, Sodium Chloride and Liquid Ammonia at different temperatures are given by Wassiliew, Ettinger and Galowkow, 1934.

100 gms. Liquid Sulfur Dioxide (SO_2) dissolve 0.018 gm. NaCN at 0°. (Glander and Ruppolt, 1937.)

Fusion-point data for mixtures of NaCN + NaCl are given by Truthe, 1934.

SODIUM CYANATE NaCNO .

CNO

100 gms. alcohol of $d_{17} = 0.799$ dissolve 0.22 gm. NaCNO at 0° and 0.5 at the b. pt.

100 gms. benzene dissolve 0.13 gm. NaCNO at the b. pt.

(Crabtree and Livingstone)

SODIUM FERRO CYANIDE $\text{Na}_4\text{Fe}(\text{CN})_6 \cdot 10\text{H}_2\text{O}$.

SOLUBILITY OF SODIUM FERRO CYANIDE IN WATER.

(Friend, Tomley and Vallance, 1929.)

t°	d. of sat. sol.	Gms. $\text{Na}_4\text{Fe}(\text{CN})_6$ per 100 gms. sat. sol.	t°	d. of sat. sol.	Gms. $\text{Na}_4\text{Fe}(\text{CN})_6$ per 100 gms. sat. sol.
0.65	1.0680	10.23	71.0	—	14.34
16.7	1.1079	14.69	75.25	—	15.82
25.35	1.1303	17.63	79.5	1.2809	18.26
35.75	1.1572	21.58	81.7 (b.pt.)	—	—
49.65	1.1921	26.20	86.0	1.285	18.5—19.5
59.75	1.2180	30.35	104.0	1.285	18.5—19.5

The solid phase below 81.7° is $\text{Na}_4\text{Fe}(\text{CN})_6 \cdot 10\text{H}_2\text{O}$.

The previous results of Conroy, 1898 and Farrow, 1926, differ only slightly from the above at temperatures up to 65°.

SOLUBILITY OF SODIUM FERROCYANIDE IN AQUEOUS SOLUTIONS
OF AMMONIA AT 18°.
(Tettamanzi, 1933.)

Gms. per 100 gms. sat. sol.		Gms. per 100 gms. sat. sol.		Gms. per 100 gms. sat. sol.	
NH ₃	Na ₄ Fe(CN) ₆	NH ₃	Na ₄ Fe(CN) ₆	NH ₃	Na ₄ Fe(CN) ₆
0.0	14.28	14.89	4.40	24.64	2.61
2.58	11.52	15.60	4.17	27.88	2.29
6.58	8.26	17.53	3.64	30.88	2.44
7.53	7.92	21.10	3.04	31.09	2.49
9.17	6.69	23.81	2.68		

The solid phase was Na₄Fe(CN)₆ · 10H₂O in all cases.

SIMULTANEOUS SOLUBILITY OF SODIUM FERROCYANIDE AND SODIUM SULFATE
IN WATER AT VARIOUS TEMPERATURES.
(Dominik, 1922.)

t°.	d of sat. sol.	Gms. per 100 cc. sat. sol.		t°.	d of sat. sol.	Gms. per 100 cc. sat. sol.	
		Na ₄ Fe(CN) ₆	Na ₂ SO ₄			Na ₄ Fe(CN) ₆	Na ₂ SO ₄
10....	1.136	8.94	7.33	34....	1.357	4.95	42.20
14....	1.147	9.46	8.58	42....	1.353	8.64	38.69
23.5..	1.228	8.64	19.53	55....	1.299	16.42	31.47
32....	1.357	4.90	42.25	63....	1.300	27.85	28.08

SOLUBILITY OF SODIUM FERROCYANIDE IN AQUEOUS SOLUTIONS
OF ETHYL ALCOHOL AT 20°.
(Diaz de Rada and Bermejo, 1929.)

Vol. % C ₂ H ₅ OH in solvent	Gms. Na ₄ Fe(CN) ₆ per 100 gms. sat. sol.	Vol. % C ₂ H ₅ OH in solvent	Gms. Na ₄ Fe(CN) ₆ per 100 gms. sat. sol.
0 (= H ₂ O)	16.77	45	0.259
10	6.745	50	0.186
15	4.535	55	0.133
20	2.909	60	0.073
25	1.618	65	0.041
30	1.126	70	0.025
35	0.614	80	0.007
40	0.481	85	0.000

SODIUM THIOCYANATE NaCNS

SOLUBILITY OF SODIUM THIOCYANATE IN WATER.
(Hughes and Mead, 1929.)

t°	Gms. NaCNS per 100 gms.		Solid Phase	t°	Gms. NaCNS per 100 gms.		Solid Phase
	H ₂ O	sat. sol.			H ₂ O	sat. sol.	
10.7	112.7	52.98	NaCNS · 11/2 H ₂ O	25.	167.8*	62.66	NaCNS
17.3	127.5	56.01	"	25	165.9	62.39* (1)	"
21.3	139.3	58.21	"	33.8	172.4	63.29	"
25.0	142.6	58.78 (1)	"	46.1	178.0	64.03	"
29.2	167.5	62.62	"	65.8	189.5	65.46	"
30.4 t.pt	—	—	" + NaCNS	73.8	196.2	66.24	"
15	164.5*	62.19	NaCNS	81.8	202.0	66.89	"
20	165.6*	62.36	"	101.4	225.6	69.29	"

* These three metastable points are by Bump, 1932.
(1) Occleshaw, 1931.

The determinations of Hughes and Mead were made by observing the temperatures at which the last crystal in a known mixture of NaCNS + H₂O began to show sharp or rounded edges with slow variations of temperature.

SOLUBILITY OF SODIUM THIOCYANATE IN METHYL ALCOHOL,
ETHYL ALCOHOL AND IN ACETONE.

(Hughes and Mead, 1929.)

Results for :

Methyl Alcohol		Ethyl Alcohol		Acetone	
t°	Gms. NaCNS per 100 gms. CH ₃ OH	t°	Gms. NaCNS per 100 gms. C ₂ H ₅ OH	t°	Gms. NaCNS per 100 gms. (CH ₃) ₂ O
15.8	35.00	18.8	18.47	18.8	6.85
24.7	40.04	35.8	19.05	29.2	9.50
34.6	45.14	52.8	21.05	41.9	14.08
48.0	50.98	61.8	22.60	51.0	18.61
52.3	53.54	70.9	24.43	56.0	21.40

In the case of Acetone the equimolecular compound NaCNS(CH₃)₂CO was formed.

The accuracy of the above results is questioned by Partington and Winterton, 1934a, who found 20.66 gms. NaCNS per 100 gms. C₂H₅OH at 25°. They consider that saturation with excess of salt is a more accurate method than observation of the point at which the last crystals in a solution shows sharp or rounded edges.

CNS

SODIUM THIOCYANATE

SOLUBILITY OF SODIUM THIOCYANATE IN ALLYL ALCOHOL
SOLUTIONS OF SODIUM IODIDE AT 25°.

(Partington and Winterton, 1934.)

Gms. per 100 gms. CH ₂ CHCH ₂ OH		Solid Phase	Gms. per 100 gms. CH ₂ CHCH ₂ OH		Solid Phase
NaI	NaSCN		NaI	NaSCN	
0.0	12.40	NaSCN	14.61	8.45	NaSCN
1.87	12.01	"	21.72	5.20	"
3.92	11.77	"	22.0	5.04	"
6.81	10.82	"	28.48	0.0	NaI
14.20	8.44	"			

100 gms. Liquid Ammonia (NH₃) dissolve 206.5 gms. NaSCN at 25°.
(Hunt, 1932.)

SODIUM CARBONATE $\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$.

SOLUBILITY IN WATER.

(Wells and McAdam, Jr., 1907; Mulder, below 27° and above 44°.)

t°.	Gms. Na_2CO_3 per 100 Gms. H_2O .	Solid Phase.	t°.	Gms. Na_2CO_3 per 100 Gms. H_2O .	Solid Phase.
0	7	$\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$	34.76	48.98	$\text{Na}_2\text{CO}_3 \cdot 7\text{H}_2\text{O}$
5	9.5	"	35.62	50.08	"
10	12.5	"	35.50	...	" + $\text{Na}_2\text{CO}_3 \cdot \text{H}_2\text{O}$
15	16.4	"	29.86	50.53	$\text{Na}_2\text{CO}_3 \cdot \text{H}_2\text{O}$
20	21.5	"	31.80	50.31	"
27.84	34.20	"	35.17	49.63	"
29.33	37.40	"	36.45	49.36	"
30.35	40.12	"	37.91	49.11	"
31.45	43.25	"	41.94	48.51	"
32.06	45.64	"	43.94	47.98	"
32.15	...	" + $\text{Na}_2\text{CO}_3 \cdot 7\text{H}_2\text{O}$	60	46.4	"
33.10	...	" + $\text{Na}_2\text{CO}_3 \cdot \text{H}_2\text{O}$	80	45.8	"
30.35	43.50	$\text{Na}_2\text{CO}_3 \cdot 7\text{H}_2\text{O}$	100	45.5	"
32.86	46.28	"	105	45.2	"

The determinations of Wells and McAdam, Jr., were made with extreme care. They correct the discrepancies which have so far existed between the solubility and transition points of the hydrates. Earlier data, which differ more or less from the above, are given by Löwel, 1851; Reich, 1891; Eppel, 1899 and Ketner, 1901-02. Single determinations at 15°, 25°, and 30° are given by Greenish and Smith (1901); Osaka (1910-1911); de Paepe (1911) and Cocheret (1911).

Sp. Gr. of solution saturated at 17.5°, 1.165 (Hager); at 18°, 1.172 (Kohlrausch); at 23°, 1.22 (Schiff); at 30°, 1.342 (Lunge). See also Wegscheider and Walter, 1905, for Sp. Gr. determinations at other temperatures.

The following determinations of the solubility of Sodium Carbonate in Water are reported by Seyer and Todd, 1929. The saturated solutions below 100° were prepared in a sealed pyrex tube having two arms which permitted separation of liquid from solid after saturation. Above 100° an iron tube having two arms was used.

t°	Gms. Na_2CO_3 per 100 gms. sat. sol.	Solid Phase	t° t°	Gms. Na_2CO_3 per 100 gms. sat. sol.	Solid Phase
-2.05 (1.056)	5.71	$\text{Ice} + \text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$	65.6	31.3	$\text{Na}_2\text{CO}_3 \cdot \text{H}_2\text{O}$
15.0 (1.1515)	14.23	$\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$	79.0	30.6	"
16.6	14.5	"	90.0	30.5	"
18.4	16.2	"	101.0	29.8	"
20.0 (1.1941)	18.0	"	122	28.7	"
20.2	17.8	"	131	28.4	"
25.0	22.5	"	140	27.6	"
25.0 (1.2416)	22.55	"	149	tr.pt.	" + Na_2CO_3
30.0	28.4	"	161	26.0	Na_2CO_3
34.8 tr.pt.	32.8	" + $\text{Na}_2\text{CO}_3 \cdot \text{H}_2\text{O}$	173	24.5	"
46.5	32.3	$\text{Na}_2\text{CO}_3 \cdot \text{H}_2\text{O}$			
52.2	32.0	"			

The results in the above table accompanied by density determinations (in parentheses) are by Flöttmann, 1928. The results for the Eutectic are by Hill and Baron, 1927.

SODIUM CARBONATE

SOLUBILITY OF SODIUM CARBONATE IN WATER AT TEMPERATURES UP TO 348°.
(Waldeck, Lynn and Hill, 1937.)

The various procedures which have been employed for solubility determinations at high temperatures are reviewed. For their own experiments the authors used a bomb made of chromium-nickel steel, provided with tubular receptical attached to the side of the bomb which was previously evacuated and served to withdraw a portion of the solution after saturation. Temperatures were maintained by means of an electrically heated air bath. The mixtures were shaken four hours for saturation. The results differ from those of Seyer and Todd especially at the transition point of monohydrate to anhydrous carbonate.

	t°	Gms. Na ₂ CO ₃ per 100 gms. sat. sol.		Solid Phase	t°	Gms. Na ₂ CO ₃ per 100 gms. sat. sol.		Solid Phase
CO	50	32.0		Na ₂ CO ₃ ·H ₂ O	139.0	28.1		Na ₂ CO ₃
	60	31.6		"	145	27.7		"
	75.5	31.0		"	159.0	26.8		"
	83.6	30.8		"	170.0	26.1		"
	99.5	30.6		"	180.0	25.0		"
	103.0	30.8		"	200	24.3		"
	106.0	30.7		"	225	20.7		"
	112.5	30.8		" + Na ₂ CO ₃	239.0	18.7		"
	116.0	30.3		Na ₂ CO ₃	275.0	13.2		"
	121.5	29.8		"	300.0	8.4		"
	125.0	29.5		"	326.0	4.4		"
	131.5	28.8		"	348.4	0.0 (1.96)		"

The vapor pressures of the saturated solutions are also given.

The result in parenthesis at 348° is by Schroeder, Berk and Gabriel 1936. It is believed that the value of 0.0 given by Waldeck, Lynn & Hill resulted from under allowance for expansion of the solution with temperature.

SODIUM (Bi) CARBONATE NaHCO₃.

SOLUBILITY IN WATER.

(Dibbitts, 1874; Fedotieff, 1904.)

t°.	Gms. NaHCO ₃ per 100 Gms.		t°.	Gms. NaHCO ₃ per 100 Gms.	
	Water.	Solution.		Water.	Solution.
0	6.9	6.5	30	11.1	10
10	8.15	7.5	40	12.7	11.3
20	9.6	8.8	50	14.45	12.6
25	10.35	9.4	60	16.4	13.8

Later results agreeing satisfactorily with the above are given by Makarow and Wachsberg, 1930.

The solubility at the Eutectic point, -2.23 , was found by Hill and Bacon, 1927 to be 6.26 gms. NaHCO_3 per 100 gms. sat. sol. of density = 1.046.

The following results for temperatures up to 200° are given by Waldeck, Lynn and Hill, 1934.

t°	Gms. NaHCO_3 per 100 gms. sat. sol.	t°	Gms. NaHCO_3 per 100 gms. sat. sol.
100	19.1	190	37.5
150	27.2	200	43.0
170	32.0		

100 gms. H_2O dissolve 9.03 gm. NaHCO_3 at 15° , $d_{15} = 1.061$.

100 gms. alcohol of 0.941 Sp. Gr. dissolve 1.2 gms. NaHCO_3 at 15.5° (Greenish and Smith, 1901.)

100 gms. glycerol dissolve 8 gms. NaHCO_3 at 15.5° . (Ossendowski, 1907.)

SODIUM CARBONATE $\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$.

SODIUM BICARBONATE NaHCO_3 .

EQUILIBRIUM IN THE SYSTEM SODIUM CARBONATE, SODIUM BICARBONATE AND WATER.
(Frenth, 1922.)

Constant stirring was employed and the solid phases were identified by the Schreinemakers « rest method ».

Results at 0°.			Results at 15°.			Results at 20°.			Solid Phase at Each Temperature.
Gms. per 100 gms. sat. sol.			Gms. per 100 gms. sat. sol.			Gms. per 100 gms. sat. sol.			
Na ₂ CO ₃ .	NaHCO ₃ .		Na ₂ CO ₃ .	NaHCO ₃ .		Na ₂ CO ₃ .	NaHCO ₃ .		
6.4	0.0		14.1	0.0		18.0	0.0		
5.9	1.4		13.8	1.8		17.3	2.9		
5.6	4.6		13.0	4.3		17.0	4.0		
4.0	5.1		6.0	6.0		6.3	6.5		
0.0	6.5		0.0	8.1		3.5	7.2		
						0.0	8.7		
									Na ₂ CO ₃ .10H ₂ O
									»
									»+NaHCO ₃
									NaHCO ₃
									»
									»
t°.	Gms. per 100 gms. sat. sol.					t°.	Gms. per 100 gms. sat. sol.		
	Na ₂ CO ₃ .	NaHCO ₃ .		Solid Phase.			Na ₂ CO ₃ .	NaHCO ₃ .	Solid Phase.
25....	22.7	0.0		Na ₂ CO ₃ .10H ₂ O		35....	32.9	0.0	Na ₂ CO ₃ .7H ₂ O
25....	22.6	1.5		»+I.1.2		35....	32.8	0.3	»
25....	20.8	2.5	I.1.2			35....	32.5	0.6	»+I.1.2
25....	17.9	4.0		»+NaHCO ₃		35....	28.7	0.9	I.1.2
25....	16.7	3.3		NaHCO ₃		35....	23.7	2.0	»
25....	10.0	3.9		»		35....	17.3	4.7	»+NaHCO ₃
25....	6.1	4.9		»		35....	9.7	6.7	NaHCO ₃
25....	0.0	9.3		»		35....	0.0	10.6	»
30....	28.45	0.0		Na ₂ CO ₃ .10H ₂ O		45....	32.2	0.0	Na ₂ CO ₃ .H ₂ O
30....	27.5	0.8		»		45....	31.7	0.9	»+I.1.2
30....	27.1	1.3		»+I.1.2		45....	27.3	1.3	I.1.2
30....	26.5	1.1	I.1.2			45....	21.4	3.0	»
30....	26.1	1.2		»		45....	16.9	5.9	»+NaHCO ₃
30....	18.3	3.8		»		45....	8.7	8.0	NaHCO ₃
30....	17.6	4.3		»+NaHCO ₃		45....	0.8	11.3	»
30....	17.5	4.6		NaHCO ₃		45....	0.0	12.0	»
30....	9.7	6.3		»		60....	31.8	0.0	Na ₂ CO ₃ .H ₂ O
30....	0.8	9.1		»		60....	30.7	1.3	»+I.1.2
30....	0.0	9.9		»		60....	25.8	2.4	I.1.2
						60....	16.9	7.4	»+NaHCO ₃
						60....	8.5	10.1	NaHCO ₃
						60....	1.4	12.9	»
I.1.2 = Na ₂ CO ₃ .NaHCO ₃ .2H ₂ O									

I. I. 2 = $\text{Na}_2\text{CO}_3 \cdot \text{NaHCO}_3 \cdot 2\text{H}_2\text{O}$

EQUILIBRIUM IN THE SYSTEM SODIUM CARBONATE, SODIUM BICARBONATE,
AND WATER AT 25°.
(McCoy and Test, 1911.)

(Forty grams of NaHCO_3 and about 200 cc. of H_2O were rotated at 25° until equilibrium was reached. Small portions of the clear solution were then analyzed by the Winkler method for carbonate content, and by titration in presence of methyl orange, for sodium. About 15 gms. of $\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$ were then added, and the mixture again rotated until equilibrium was reached, and again analyzed. This was continued and the following results were obtained.)

	Per cent of Total Na Present as Bicarbonate.	Gms. Na per Liter.	Gms. Bicarbonate per Liter.	Gms. Carbonate per Liter.	Solid Phase.
	0	119.9	0	276.4	$\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$
	5.92	127.6	27.6	276.3	" + $\text{Na}_2\text{CO}_3 \cdot \text{NaHCO}_3 \cdot 2\text{H}_2\text{O}$
	7.5	120	...	...	$\text{Na}_2\text{CO}_3 \cdot \text{NaHCO}_3 \cdot 2\text{H}_2\text{O}$
	10	107	...	...	"
	12.89	108	50.8	216.6	" + NaHCO_3
	15	100	...	...	\text{NaHCO_3
CO	20	80	...	...	"
	32	60	...	...	"
	56	40	...	...	"
	80	30	...	...	"
	100	27.02	98.7	0	"

The following data for this system also at 25°, but given in terms of weight instead of volume of solution, are reported by de Paepe (1911).

Gms. per 100 Gms. H_2O		Solid Phase.	Gms. per 100 Gms. H_2O		Solid Phase.
Na_2CO_3	NaHCO_3		Na_2CO_3	NaHCO_3	
28.3	0	$\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$	12.4	7.3	NaHCO_3
27.3	2.1	"	6.2	9	
26.5	4.2	" + NaHCO_3	1	10.1	
19.2	5.7	NaHCO_3			

SODIUM CARBONATE

EQUILIBRIUM IN THE SYSTEM SODIUM CARBONATE
SODIUM BICARBONATE AND WATER.

(Hill and Bacon, 1927.)

d. of	Gms. per 100 gms. sat. sol.		Solid Phase	d. of	Gms. per 100 gms. sat. sol.		Solid Phase
sat. sol.	Na_2CO_3	NaHCO_3		sat. sol.	Na_2CO_3	NaHCO_3	
Results at 24.87°				Results at 30° con.			
—	22.45	0.0	$\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$	1.269	24.30	1.47	1.1.2
1.238	22.20	0.86	"	1.256	23.39	1.79	"
1.243	22.26	1.09	"	1.239	21.00	2.65	"
1.247	22.15	1.59	"	1.226	18.54	3.91	"
—	22.10	2.09	" + 1.1.2	1.216	17.52	4.45	" + NaHCO_3
1.240	20.90	2.49	1.1.2	1.160	11.84	5.60	NaHCO_3
1.228	19.31	3.18	"	1.112	6.06	7.30	"
1.225	18.60	3.57	"	1.068	0.25	9.71	"
1.216	17.85	4.00	" + NaHCO_3	—	0.0	9.8	"
1.179	13.61	4.90	NaHCO_3	Results at 50°			
1.152	10.88	5.50	"	1.331	32.16	0.0	$\text{Na}_2\text{CO}_3 \cdot \text{H}_2\text{O}$
1.125	8.11	6.13	"	1.337	31.92	0.48	" + 1.1.2
1.076	8.21	2.10	"	1.260	23.79	2.40	1.1.2
1.065	9.11	0.2	"	1.214	16.97	6.28	" + NaHCO_3
—	9.3	0.0	"	1.196	14.90	6.80	NaHCO_3
Results at 30°				1.152	10.04	8.27	"
1.296	28.24	0.0	$\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$	1.112	4.78	9.93	"
1.307	28.09	0.76	" + 1.1.2	1.079	1.08	11.68	"
1.301	27.52	0.82	1.1.2	—	0.0	12.40	"

The authors also determined four invariant points of the system.

t°	d. of	Gms. per 100 gms. sat. sol.		Solid Phase
	sat. sol.	Na_2CO_3	NaHCO_3	
- 3.32	1.078	4.41	4.64	$\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$ + NaHCO_3 + Ice
+ 21.26	1.220	18.15	3.74	$\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$ + $\text{NaHCO}_3 \rightleftharpoons 1.1.2$
31.98	1.334	31.32	0.16	$\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$ + 1.1.2 \rightleftharpoons $\text{Na}_2\text{CO}_3 \cdot 7\text{H}_2\text{O}$
35.17	1.350	33.08	0.19	$\text{Na}_2\text{CO}_3 \cdot 7\text{H}_2\text{O}$ + 1.1.2 \rightleftharpoons $\text{Na}_2\text{CO}_3 \cdot \text{H}_2\text{O}$

1.1.2 = $\text{Na}_2\text{CO}_3 \cdot \text{NaHCO}_3 \cdot 2\text{H}_2\text{O}$ (Trona)

Results at 25° differing somewhat from the above are given by Makarow and Jakimow, 1933.

This system has also been very completely studied by Wegschneider and Mehl, 1928, who give results for eleven isotherms between 20° and 94.5°. They also give results for an unstable form of Sodium carbonate obtained by the decomposition of the double salt 1.1.2 (Trona) with water.

SODIUM CARBONATE

EQUILIBRIUM IN THE SYSTEM SODIUM CARBONATE, SODIUM
BICARBONATE AND WATER AT TEMPERATURES FROM 100° TO 200°.
(Waldock, Lynn and Hill, 1934.)

The chromium nickel steel bomb which was used differed from that employed for the solubility of sodium carbonate in water up to 348° in that the sampling receptacle was set in from the top instead of on the side.

	Gms. per 100 gas. sat. sol.		Solid Phase	Gms. per 100 gas. sat. sol.		Solid Phase
	Na_2CO_3	NaHCO_3		Na_2CO_3	NaHCO_3	
CO	Results at 100°			Results at 170°		
	30.7	0.0	$\text{Na}_2\text{CO}_3 \cdot \text{H}_2\text{O}$	26.0	0.0	Na_2CO_3
	29.9	2.3	"	18.9	18.3	" + 1.1.2
	29.1	4.2	" + 1.1.2	18.4	19.7	1.1.2
	26.7	5.9	1.1.2	13.5	24.3	" + 1.3
	25.3	7.1	"	9.7	28.4	1.3
	23.6	8.2	"	7.5	31.2	" + NaHCO_3
	21.1	9.7	" + 1.3	3.6	31.7	NaHCO_3
	19.3	10.7	1.3	Results at 190°		
	16.5	11.9	"	19.7	11.6	Na_2CO_3
	13.4	14.4	"	17.2	20.7	"
	12.7	14.4	" + NaHCO_3	16.7	25.5	" + 1.1.2
	15.3	13.8*	NaHCO_3	13.7	28.9	1.1.2
	8.7	16.0	"	10.2	33.0	" + 1.3
	1.2	18.5	"	7.0	35.0	1.3 + NaHCO_3
	Results at 150°			1.7	36.8	NaHCO_3
	27.5	0.0	Na_2CO_3	Results at 200°		
	24.4	7.4	"	19.9	7.5	Na_2CO_3
	20.9	15.9*	"	16.9	20.3	"
	23.1	10.2	" + 1.1.2	15.4	30.5	" + 1.3
	22.4	11.9	1.1.2	13.0	32.4	1.3
	20.7	15.4	" + 1.3	9.0	36.4	" + NaHCO_3
	13.8	20.0	1.3	6.1	38.6	NaHCO_3
	8.4	25.6	" + NaHCO_3			
	2.5	26.8	NaHCO_3			

1.1.2 = $\text{Na}_2\text{CO}_3 \cdot \text{NaHCO}_3 \cdot 2\text{H}_2\text{O}$; 1.3 = $\text{Na}_2\text{CO}_3 \cdot 3\text{NaHCO}_3$.

Results are also given for five additional invariant points.

EQUILIBRIUM IN THE SYSTEM SODIUM CARBONATE, SODIUM BICARBONATE,
SODIUM CHLORIDE AND WATER AT VARIOUS TEMPERATURES.
(Freeth, 1922.)

Na10 = $\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$; Na7 = $\text{Na}_2\text{CO}_3 \cdot 7\text{H}_2\text{O}$; Na1 = $\text{Na}_2\text{CO}_3 \cdot \text{H}_2\text{O}$; NaH = NaHCO_3 ;
1.1.2 = $\text{Na}_2\text{CO}_3 \cdot \text{NaHCO}_3 \cdot 2\text{H}_2\text{O}$ (sodium sesquicarbonate).

Gms. per 100 gms. sat. sol.				Gms. per 100 gms. sat. sol.			
Na_2CO_3	NaHCO_3	NaCl	Solid Phase.	Na_2CO_3	NaHCO_3	NaCl	Solid Phase.
Results at 0°.				Results at 20°.			
3.78	3.51	4.81	Na10 + NaH	16.17	3.40	2.22	Na10 + NaH + 1.1.2
2.89	2.83	9.53	"	13.40	2.60	7.90	Na10 + 1.1.2
2.39	2.14	15.14	"	12.58	1.07	13.97	"
2.63	0.92	21.32	"	13.40	0.61	17.54	Na10 + 1.1.2 + NaCl
2.77	1.11	22.84	" + 1.1.2	8.48	0.69	20.50	1.1.2 + NaCl
2.99	0.73	23.86	Na10 + NaCl + "	5.35	0.84	22.38	"
2.72	0.96	23.88	NaH + NaCl + "	14.60	3.51	3.87	1.1.2 + NaH
2.77	0.92	23.86	"	12.70	3.09	6.03	"
1.30	0.73	25.05	"	11.52	2.86	7.64	"
				6.99	2.83	13.43	"
				2.60	1.53	23.74	1.1.2 + NaH + NaCl
Results at 15°.				Results at 25°.			
11.42	4.05	3.06	Na10 + NaH				
9.62	2.33	7.71	"				
9.74	1.41	11.19	" + 1.1.2	19.84	1.34	5.01	Na10 + 1.1.2 CO
9.33	2.06	11.58	"	18.99	0.76	11.09	"
4.80	1.91	18.52	NaH + 1.1.2	18.99	0.80	11.38	Na10 + 1.1.2 + Na7
8.48	1.38	15.24	Na10 + 1.1.2	18.36	0.53	12.84	1.1.2 + Na7
9.11	0.19	20.49	Na10 + 1.1.2 + NaCl	17.28	0.34	15.28	1.1.2 + Na7 + NaCl
6.41	0.08	22.18	"	13.28	0.61	17.72	1.1.2 + NaCl
4.70	0.31	23.22	"	7.28	0.53	21.35	"
3.25	0.61	23.93	NaH + 1.1.2 + NaCl	11.35	2.90	7.57	1.1.2 + NaH
				6.65	1.95	15.04	"
				2.55	1.38	23.97	" + NaCl
Gms. per 100 gms. sat. sol.				Gms. per 100 gms. sat. sol.			
Na_2CO_3	NaHCO_3	NaCl	Solid Phase.	Na_2CO_3	NaHCO_3	NaCl	Solid Phase.
Results at 30°.				Results at 45°.			
26.61	0.99	3.65	1.1.2 + Na10 + Na7	23.35	1.03	7.84	1.1.2 + Na1
22.63	0.61	9.88	" + Na1 + "	18.97	0.50	12.62	"
17.79	0.53	14.88	" + " + NaCl	14.34	0.61	17.40	" + NaCl
13.20	0.99	17.69	" + NaCl	9.25	0.15	20.62	" + NaCl
7.33	0.96	21.30	"	6.84	0.50	21.98	"
11.21	3.32	7.70	" + NaH	6.29	0.76	22.35	"
6.70	2.25	14.96	"	4.29	1.11	23.43	"
25.3	1.68	24.01	" + NaCl	12.44	5.08	5.38	" + NaHCO ₃
				10.75	3.29	8.91	"
				6.94	2.52	14.70	"
				3.04	1.99	23.91	" + NaCl
Results at 35°.				Results at 60°.			
21.96	0.12	8.30	1.1.2 + Na1				
18.46	0.11	12.08	"				
30.27	0.57	1.97	" + Na7	25.59	1.57	4.73	1.1.2 + Na1
17.04	0.61	15.52	" + NaCl	18.87	0.80	11.94	"
13.23	0.57	17.85	" + NaCl	12.39	0.53	19.13	" + NaCl
7.42	0.61	21.41	"	10.75	0.73	20.06	" + NaCl
11.57	3.59	7.61	" + NaH	14.00	6.11	3.73	" + NaHCO ₃
6.72	2.56	14.85	"	8.99	4.16	11.34	"
5.52	2.10	16.97	"	3.45	1.83	23.88	" + NaCl
3.25	0.76	23.75	" + NaCl				

Additional experiments upon this system made at 30°, 49.7° and at 89.5° are reported by Wegschneider and Mehl, 1928. These authors employed solutions in which the ratio of NaCl to H₂O was kept constant throughout. They make no reference to the previous results of Freeth.

The following additional determinations of this system at 35° are given by Teeple, 1929.

Gms. per 100 gms. H ₂ O			Solid Phase
Na ₂ CO ₃	NaHCO ₃	NaCl	
21.8	—	24.0	Na ₂ CO ₃ · 11H ₂ O + NaCl
—	2.0	35.2	NaHCO ₃ + "
49.2	0.8	—	Na ₂ CO ₃ · 11H ₂ O + 1.1.2 (trona)
21.8	6.2	—	NaHCO ₃ + "
24.7	0.3	24.0	Na ₂ CO ₃ · 11H ₂ O + " + NaCl
4.2	1.8	33.5	NaHCO ₃ + " + "

EQUILIBRIUM IN THE SYSTEM SODIUM CARBONATE, SODIUM
BICARBONATE, SODIUM SULFATE AND WATER AT 25°.
(Makarov and Jakimow, 1933.)

CO

Gms. per 100 gms. sat. solution			Solid Phase
Na ₂ CO ₃	NaHCO ₃	Na ₂ SO ₄	
16.5	3.86	5.88	NaHCO ₃ + 1.1.2
13.41	3.00	13.72	" "
19.48	1.84	8.50	Na ₂ CO ₃ · 10H ₂ O + 1.1.2
18.50	1.72	11.64	" "
14.79	1.58	16.50	Na ₂ SO ₄ · 10H ₂ O + "
7.09	3.28	18.26	NaHCO ₃ + Na ₂ SO ₄ · 10H ₂ O
11.08	2.54	17.05	" + " + 1.1.2
17.62	1.76	16.21	Na ₂ CO ₃ · 10H ₂ O + Na ₂ SO ₄ · 10H ₂ O + 1.1.

The following additional determinations of this system at 20° are given by Teeple, 1929.

Gms. per 100 gms. H ₂ O			Solid Phase
Na ₂ CO ₃	NaHCO ₃	Na ₂ SO ₄	
—	5.4	17.1	NaHCO ₃ + Na ₂ SO ₄ · 10H ₂ O
6.9	—	15.8	Na ₂ SO ₄ · 10H ₂ O
20.1	—	14.9	" + Na ₂ CO ₃ · 10H ₂ O
20.3	—	12.5	Na ₂ CO ₃ · 10H ₂ O
20.6	3.9	14.7	" + NaHCO ₃ + Na ₂ SO ₄ · 10H ₂ O
20.8	4.8	8.1	" + " "
9.7	4.5	15.5	Na ₂ SO ₄ · 10H ₂ O + NaHCO ₃

SOLUBILITY OF SODIUM CARBONATE IN AQUEOUS SOLUTIONS OF SODIUM BROMIDE AND OF SODIUM IODIDE AT 30°.
(Cocheret, 1911.)

In Aq. NaBr Solutions.

Gms. per 100 H ₂ O.	Gms. Sat. Sol.	Solid Phase.
Na ₂ CO ₃ .	NaBr.	
27.98	0	Na ₂ CO ₃ .10H ₂ O
27.54	2.41	"
26.72	4.06	"
26.23	6.26	" + Na ₂ CO ₃ .7H ₂ O
23.40	11	Na ₂ CO ₃ .7H ₂ O
22.68	12.22	"
19.86	16.88	"
19.57	16.95	" + Na ₂ CO ₃ .H ₂ O
18.11	19.32	Na ₂ CO ₃ .H ₂ O
8.45	33.39	"
6.90	36.13	"
3.04	44.75	"
2.99	45.31	" + NaBr.2H ₂ O
2.60	45.68	NaBr.2H ₂ O
0	49.40	"

In Aq. NaI Solutions.

Gms. per 100 H ₂ O.	Gms. Sat. Sol.	Solid Phase.
Na ₂ CO ₃ .	NaI.	
26.5	2.4	Na ₂ CO ₃ .10H ₂ O
25.5	4.7	"
24.4	8.6	"
24.3	9.5	" + Na ₂ CO ₃ .7H ₂ O
23	11.2	Na ₂ CO ₃ .7H ₂ O
20.8	14	"
18.7	18.4	"
15.3	25.4	" + Na ₂ CO ₃ .H ₂ O
13.1	29.1	Na ₂ CO ₃ .H ₂ O
10.4	33.3	"
4.2	46	"
2.7	51	"
0.9	57.6	"
0.3	65.6	" + NaI.2H ₂ O
0	65.5	NaI.2H ₂ O

SOLUBILITY OF SODIUM CARBONATE IN AQUEOUS SOLUTIONS OF SODIUM CHLORIDE AT 15°.

(Reich, 1891.)

Gms. per 100 H ₂ O.	Gms. NaCl per 100 Gms. Solution.	Gms. Na ₂ CO ₃ per 100 Gms. NaCl Solution.	Gms. per 100 H ₂ O.	Gms. NaCl per 100 Gms. Solution.	Gms. Na ₂ CO ₃ per 100 Gms. NaCl Solution.
NaCl.	Na ₂ CO ₃ .10H ₂ O.		NaCl.	Na ₂ CO ₃ .10H ₂ O.	
0	61.42	0	23.70	39.06	15.96
4.03	53.86	2.92	27.93	39.73	18.26
8.02	48	5.80	31.65	41.44	20.06
12.02	43.78	8.61	35.46	43.77	21.75
16.05	40.96	11.31	37.23	45.27*	22.46
19.82	39.46	13.71			10.13

* Both salts in solid phase.

SOLUBILITY OF SODIUM CARBONATE IN AQUEOUS SODIUM CHLORIDE AT 30°.
(Cocheret, 1911.)

Gms. per 100 H ₂ O.	Gms. Sat. Sol.	Solid Phase.	Gms. per 100 H ₂ O.	Gms. Sat. Sol.	Solid Phase.
Na ₂ CO ₃ .	NaCl.		Na ₂ CO ₃ .	NaCl.	
27.98	0	Na ₂ CO ₃ .10H ₂ O	20.72	11.49	Na ₂ CO ₃ .H ₂ O
27.48	0.90	"	18	14.12	" + NaCl
27.12	3.33	"	14.81	16.26	NaCl
26.82	4.15	" + Na ₂ CO ₃ .7H ₂ O	9.71	18.76	"
25.59	5.17	Na ₂ CO ₃ .7H ₂ O	5.65	21.94	"
24.26	5.93	"	0	26.47	"
22.75	10.24	" + Na ₂ CO ₃ .H ₂ O			

(Freeth, 1922.)

Saturation was secured by means of constant stirring in a thermostat.

Results at 0°.		Results at 15°.		Results at 20°.		Solid Phase at Each Temperature
Gms. per 100 gms. sat. sol.		Gms. per 100 gms. sat. sol.		Gms. per 100 gms. sat. sol.		
Na_2CO_3	NaCl	Na_2CO_3	NaCl	Na_2CO_3	NaCl	
6.6	0.0	14.1	0.0	17.6	0.0	$\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$
4.3	4.5	9.9	9.9	15.5	4.0	"
3.7	8.2	8.7	14.7	14.1	7.7	"
3.1	12.3	—	—	12.9	12.8	"
2.9	15.6	— (10.6)	— (7.2)	—	—	"
2.8	20.4	— (10.2)	— (13.7)	—	—	"
2.8 (3.16)	24.2 (25.5)	9.2 (9.6)	20.2 (20.4)	13.5	17.4	"
0.0	26.3	3.5 (3.1)	24.0 (24.3)	6.9	22.0	NaCl
		0.0	26.3	9.5	20.3	"
				11.5	18.9	"
				0.0	26.4	"

The results in parentheses are by Mondain-Monval, 1922.

CO	Gms. per 100 gms. sat. sol.		Solid Phase.	t°	Gms. per 100 gms. sat. sol.		Solid Phase
	Na_2CO_3	NaCl			Na_2CO_3	NaCl	
	22.7	0.0	$\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$	15...	32.9	0.0	$\text{Na}_2\text{CO}_3 \cdot 7\text{H}_2\text{O}$
	19.6	5.6	"	15...	31.5	2.0	"
	18.8	10.8	"	15...	31.0	2.5	" + Na_2CO_3
	19.0	11.8	" + $\text{Na}_2\text{CO}_3 \cdot 7\text{H}_2\text{O}$	15...	30.2	2.9	$\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$
	18.4	13.0	$\text{Na}_2\text{CO}_3 \cdot 7\text{H}_2\text{O}$	15...	25.5	7.1	"
	17.3	15.5	" + NaCl	15...	16.8	16.1	" + NaCl
	7.9	21.3	NaCl	15...	7.4	21.7	NaCl
	0.0	26.4	"	15...	4.0	24.0	"
	28.5	0.0	$\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$	40...	39.2	0.0	$\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$
	27.0	3.7	"	40...	28.2	3.9	"
	26.9	3.9	" + $\text{Na}_2\text{CO}_3 \cdot 7\text{H}_2\text{O}$	40...	24.4	7.3	"
	26.6	4.2	$\text{Na}_2\text{CO}_3 \cdot 7\text{H}_2\text{O}$	40...	20.7	11.1	"
	24.6	7.2	"	40...	17.6	14.6	"
	22.7	9.3	"	40...	15.0	17.4	" + NaCl
	22.5	10.2	" + $\text{Na}_2\text{CO}_3 \cdot 7\text{H}_2\text{O}$	40...	10.3	20.2	NaCl
	21.9	10.4	$\text{Na}_2\text{CO}_3 \cdot 7\text{H}_2\text{O}$	40...	3.6	24.2	"
	20.5	11.1	"	60...	11.8	0.0	$\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$
	21.2	12.9	$\text{Na}_2\text{CO}_3 \cdot 7\text{H}_2\text{O}$ + NaCl	60...	24.0	7.2	"
	17.7	15.0	$\text{Na}_2\text{CO}_3 \cdot 7\text{H}_2\text{O}$ + NaCl	60...	20.2	10.9	"
	5.0	22.7	NaCl	60...	16.6	14.5	"
	0.0	26.5	"	60...	13.9	17.8	" + NaCl

The following results for the invariant points at other temperatures are given by Makarow, 1932.

t°	Gms. per 100 gms. sat. sol.		Solid Phase
	Na_2CO_3	NaCl	
-21.4	1.4	23.0	$\text{Ice} + \text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O} + \text{NaCl} \cdot 2\text{H}_2\text{O}$
-1.2	2.6	24.4	$\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O} + \text{NaCl} \cdot 2\text{H}_2\text{O} + \text{NaCl}$
+21.0	15.1	16.7	" + $\text{Na}_2\text{CO}_3 \cdot 7\text{H}_2\text{O}$ + "
22	15.8	16.7	" + " + "
"	16.3	14.7	$\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$ + "
26.2	30.2	10.0	" + " + NaCl
"	18.5	14.3	$\text{Na}_2\text{CO}_3 \cdot 7\text{H}_2\text{O}$ + " + NaCl
27.0	21.6	8.8	$\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$ + "
"	19.2	13.6	$\text{Na}_2\text{CO}_3 \cdot 7\text{H}_2\text{O}$ + "
"	18.3	14.5	" + " + "

EQUILIBRIUM IN THE SYSTEM SODIUM BICARBONATE, SODIUM CHLORIDE
AND WATER.

(Freeth, 1922.)

Results at 0°.		Results at 15°.		Results at 20°.		Results at 25°.		Solid Phase at Each Temp.
Gms. per 100 gms. sat. sol.		Gms. per 100 gms. sat. sol.		Gms. per 100 gms. sat. sol.		Gms. per 100 gms. sat. sol.		
NaHCO ₃ .	NaCl.	NaHCO ₃ .	NaCl.	NaHCO ₃ .	NaCl.	NaHCO ₃ .	NaCl.	
6.5	0.0	8.1	0.0	8.7	0.0	9.3	0.0	NaHCO ₃
2.7	8.8	3.8	8.6	4.2	8.5	3.2	12.7	»
1.1	19.8	2.0	16.4	1.7	19.5	1.8	19.7	»
0.6	25.9	0.9 (0.77)	26.1 (26.1)	1.0	26.1	1.2	26.0	» + NaCl

The results in parentheses are by Toporescu, 1922.

Results at 30°.		Result at 33°.		Result at 43°.		Result at 60°.		Solid Phase at Each Temp.
Gms. per 100 gms. sat. sol.		Gms. per 100 gms. sat. sol.		Gms. per 100 gms. sat. sol.		Gms. per 100 gms. sat. sol.		
NaHCO ₃ .	NaCl.	NaHCO ₃ .	NaCl.	NaHCO ₃ .	NaCl.	NaHCO ₃ .	NaCl.	
9.9	0.0	10.6	0.0	12.0	0.0	14.1	0.0	NaHCO ₃
4.9	8.8	4.7	10.3	5.8	10.5	7.4	10.0	»
1.9	19.5	2.1	19.6	2.7	19.2	8.7	19.1	»
1.2	26.1	1.3	26.2	1.5	26.2	2.2	26.4	» + NaCl

SOLUBILITY OF SODIUM BICARBONATE IN AQUEOUS SOLUTIONS OF SODIUM
CHLORIDE SATURATED WITH CO₂.

CO

(Fedotieff; see also Reich, 1891.)

t°.	Wt. of 1 cc. Solution.	Mols. per 1000 Gms. H ₂ O.		Grams per 1000 Gms. H ₂ O.	
		NaCl.	NaHCO ₃ .	NaCl.	NaHCO ₃ .
0	..	0.0	0.82	0.0	69.0
"	1.208	6.0	0.09	350.1	7.7
15	1.056	0.0	1.05	0.0	88.0
"	1.063	0.52	0.82	30.2	68.6
"	1.073	1.03	0.64	60.1	53.6
"	1.096	2.11	0.41	123.1	34.8
"	1.127	3.20	0.28	187.2	23.0
"	1.158	4.39	0.19	256.9	16.1
"	1.203	6.06	0.12	354.6	10.0
30	1.066	0.0	1.31	0.0	110.2
"	1.079	1.02	0.87	59.9	72.8
"	1.100	2.08	0.56	121.9	47.3
"	1.127	3.18	0.38	186.3	32.0
"	1.156	4.38	0.27	256.0	22.3
"	1.199	6.12	0.17	358.1	13.9
45	1.077	0.0	1.65	0.0	138.6
"	1.086	1.04	1.12	60.7	94.0
"	1.115	2.65	0.62	155.2	52.0
"	1.127	3.24	0.52	189.4	43.4
"	1.155	4.38	0.37	256.1	30.7
"	1.198	6.18	0.23	361.5	19.5

SODIUM CARBONATE

EQUILIBRIUM IN THE SYSTEM SODIUM CARBONATE, SODIUM CHLORIDE AND SODIUM SULFATE.

(Teepie, 1929.)

Gms. per 100 gms. H ₂ O			Solid	Gms. per 100 gms. H ₂ O			Solid
Na ₂ CO ₃	Na ₂ SO ₄	NaCl	Phase	Na ₂ CO ₃	Na ₂ SO ₄	NaCl	Phase
Results at 20°				Results at 35° (con.)			
20.1	14.9	—	C. 10 + S. 10	24.2	2.7	23.2	C. 1 + Cl + B
20.3	12.5	—	C. 10	4.6	8.8	30.7	S + Cl + B
6.9	15.8	—	S. 10	Results at 50°			
19.8	—	25.4	C. 10 + Cl	—	7.3	33.7	S + Cl
18.0	—	9.9	C. 10	20.9	—	27.0	C. 1 + Cl
17.4	—	17.2	"	44.4	6.3	—	C. 1 + B
—	13.0	29.0	S. 10 + S	12.6	36.7	—	S + B
—	12.5	11.8	S. 10	20.2	2.0	26.4	C. 1 + Cl + B
—	11.7	20.4	"	2.9	7.7	32.9	S + Cl + B
—	12.1	26.2	"	Results at 75°			
—	11.0	31.8	S + Cl	—	6.8	35.5	S + Cl
13.5	—	28.9	Cl	16.4	—	30.8	C. 1 + Cl
18.8	13.8	11.5	C. 10 + S. 10 + B	42.9	5.4	—	C. 1 + B
19.7	11.2	17.3	C. 10 + B	7.9	39.0	—	S + B
19.2	13.8	7.2	C. 10 + S. 10	16.6	1.4	30.3	C. 1 + B + Cl
21.1	6.2	23.2	" + Cl + B	1.5	6.7	35.2	S + B + Cl
11.0	14.1	21.4	" + S + B	Results at 100°			
8.3	10.5	28.5	Cl + " + "	—	6.5	37.3	S + Cl

CO

Results at 35°				Results at 100°			
—	9.2	33.6	S + Cl	—	6.5	37.3	S + Cl
24.8	—	23.9	C. 1 + Cl	15.1	—	33.5	Cl + C. 1
45.8	6.9	—	C. 1 + B	1.3	6.7	37.2	Cl + S + B
18.5	34.3	—	S + B	14.9	0.9	33.1	Cl + C. 1 + B

C. 10 = Na₂CO₃ · 10H₂O; C. 1 = Na₂CO₃ · H₂O; S. 10 = Na₂SO₄ · 10H₂O; S = Na₂SO₄
 Cl = NaCl; B = Burkeite, Na₂CO₃ · 2Na₂SO₄.

EQUILIBRIUM IN THE SYSTEM SODIUM BICARBONATE, SODIUM CHLORIDE, SODIUM SULFATE AND WATER AT 20°.

(Teepie, 1929.)

Gms. per 100 gms. H ₂ O			Solid Phase	Gms. per 100 gms. H ₂ O			Solid Phase
NaHCO ₃	Na ₂ SO ₄	NaCl		NaHCO ₃	Na ₂ SO ₄	NaCl	
5.4	17.1	—	NaHCO ₃ + S. 10	—	13.0	29.0	S. 10 + S
—	12.5	11.8	S. 10	2.1	13.2	27.8	NaHCO ₃ + S.
—	11.7	20.4	"	2.0	12.5	25.8	" + "
—	12.1	26.2	"	1.7	10.8	31.4	" + NaCl

S. 10 = Na₂SO₄ · 10H₂O; S = Na₂SO₄.

EQUILIBRIUM IN THE SYSTEM SODIUM BICARBONATE, SODIUM CHLORIDE
AND WATER UNDER 1.2 ATMOSPHERES PRESSURE OF CARBON DIOXIDE.
(Neumann and Donke, 1928.)

Results at 20°

Results at 30°

Results at 40°

Gms. per 1000 cc sat. sol.		Gms. per 1000 gms. sat. sol.		Gms. per 100 cc sat. sol.	
NaCl	NaHCO ₃	NaCl	NaHCO ₃	NaCl	NaHCO ₃
0.0	90.8	0.0	104.2	0.0	119.6
45.5	61.7	34.1	80.0	98.5	56.9
143.0	33.3	103.2	47.3	178.6	35.6
310.9	9.92	311.3	12.6	311.9	15.6
312.3	0.0	314.4	0.0	316.0	0.0

SOLUBILITY OF SODIUM BICARBONATE IN AQUEOUS AMMONIUM BICARBONATE
SOLUTIONS SATURATED WITH CO₂.

(Fedotieff, 1901.)

t°.	Wt. of 1 cc. Solution.	Mols. per 1000 Gms. H ₂ O.		Grams per 1000 Gms. H ₂ O.	
		NH ₄ HCO ₃	NaHCO ₃	NH ₄ HCO ₃	NaHCO ₃
0	1.072	1.39	0.58	109.4	48.2
"	...	0.0	0.82	0.0	69.0
15	1.056	0.0	1.05	0.0	88.0
"	1.061	0.29	0.95	23.0	80.0
"	1.065	0.56	0.89	44.0	74.6
"	1.073	1.08	0.79	85.7	66.7
"	1.090	2.16	0.71	170.6	59.2
30	...	0.0	1.65	0.0	138.6
"	...	2.91	0.83	230	70.0

EQUILIBRIUM IN THE SYSTEM SODIUM CARBONATE, SODIUM HYDROXIDE,
SODIUM CHLORIDE AND WATER AT VARIOUS TEMPERATURES. (Froeth, 1922.)

Gms. per 100 gms. sat. sol.			Solid Phase.	Gms. per 100 gms. sat. sol.			Solid Phase.
Na ₂ CO ₃	NaOH.	NaCl.		Na ₂ CO ₃	NaOH.	NaCl.	
Results at 0°.				Results at 20°.			
2.4	8.4	17.3	Na 10+NaCl	12.8	1.7	16.9	Na 10+Na 7+NaCl.
2.4	14.3	12.7	" "	11.6	9.5	6.9	" "
2.8	16.0	11.2	" " +Na 7	12.0	3.6	15.9	NaCl+ "
2.9	20.5	4.2	" +Na 7	9.6	8.5	13.4	" "
2.9	19.9	8.5	Na 1 + " +NaCl	9.6	9.7	12.4	" " +Na 1
3.4	22.1	4.2	" "	10.1	12.4	7.5	Na 1+ "
2.2	25.1	6.9	" +NaCl	10.6	15.5	1.9	" "
1.9	23.0	6.5	" "	7.0	12.3	11.9	" +NaCl
1.2	25.8	5.6	" "	1.2	25.1	6.6	" "
0.6	29.2	4.3	" "	1.7	46.7	0.9	" "
Results at 15°.				Results at 25°.			
9.2	1.5	19.4	Na 10+NaCl	18.1	1.7	8.6	Na 10+Na 7
8.4	5.8	16.2	" "	18.3	6.3	3.3	" "
8.7	7.4	14.9	" " +Na 7	15.9	1.7	15.0	NaCl+ "
7.9	10.4	10.5	" +Na 7	14.9	8.6	6.4	Na 1+ "
8.7	15.6	2.4	" "	15.2	11.0	3.2	" + "
7.5	10.6	12.7	NaCl+ "	13.5	4.4	14.1	" + " +NaCl
7.2	12.5	11.7	" " +Na 1	9.1	8.9	13.5	" +NaCl
8.2	13.6	9.6	Na 7+Na 1	3.1	18.5	9.9	" "
7.9	17.7	3.1	" "	0.3	41.5	1.5	" "
1.9	23.1	7.4	NaCl+ "	0.3	44.0	1.3	" "
0.2	46.2	0.9	" "	0.5	45.7	1.1	" +Na ₂ CO ₃
				0.2	49.9	1.0	NaCl+Na ₂ CO ₃

EQUILIBRIUM IN THE SYSTEM SODIUM CARBONATE, SODIUM HYDROXIDE
SODIUM CHLORIDE AND WATER AT VARIOUS TEMPERATURES (CON.).
(Freeth, 1922.)

Gms. per 100 gms. sat. sol.			Solid Phase.	Gms. per 100 gms. sat. sol.			Solid Phase.
Na ₂ CO ₃ .	NaOH.	NaCl.		Na ₂ CO ₃ .	NaOH.	NaCl.	
Results at 30°.				Results at 45°.			
26.7	2.2	1.2	Na ₁₀ + Na ₇	9.2	6.1	16.7	Na ₁ + NaCl
23.1	1.5	7.6	Na ₁ + "	2.9	18.1	10.8	" "
22.4	5.2	2.9	" "	0.4	33.4	3.8	" "
6.0	12.4	12.5	" + NaCl	0.3	37.2	2.7	" + Na
0.2	34.6	3.0	" + "	0.3	38.8	2.4	Na ₂ CO ₃ + NaCl
0.2	41.8	1.5	" + " + Na ₂ CO ₃	0.2	40.4	2.1	" "
0.2	51.3	1.0	Na ₂ CO ₃ + NaCl	0.5	54.1	1.3	" "
Results at 35°.				Results at 60°.			
11.0	5.4	15.3	Na ₁ + NaCl	5.8	9.4	15.8	Na ₁ + NaCl
4.6	14.7	11.8	" "	2.6	18.1	11.3	" "
1.4	24.9	7.0	" "	1.7	22.3	8.4	" "
0.3	40.8	1.8	" + Na ₂ CO ₃	0.5	33.2	4.3	" + Na
1.0	49.0	1.2	Na ₂ CO ₃ + NaCl	0.2	52.6	1.7	Na ₂ CO ₃ + NaCl

The following temperatures of the fixed points were determined.

SOLID PHASES IN CONTACT WITH SOLUTION.

t°.		t°.	
21.0.....	Na ₁₀ + NaCl + Na ₇	31.0.....	Na ₁₀ + Na ₇ +
26.2.....	Na ₇ + NaCl + Na ₁	34.5.....	Na ₇ + Na ₁ +
19.7.....	Na ₁₀ + NaH + 1.1.2		

CO

Na₁₀ = Na₂CO₃ · 10 H₂O; Na₇ = Na₂CO₃ · 7 H₂O; Na₁ = Na₂CO₃ · H₂O
NaH = NaHCO₃; 1.1.2 = Na₂CO₃ · NaHCO₃ · 2 H₂O (sodium sesqui carbonate)

EQUILIBRIUM IN THE SYSTEM SODIUM CARBONATE, SODIUM CHLORATE
AND WATER AT 24° 2.

(Bjinsky, 1924.)

The solutions were actively shaken at constant temperature and the attainment of equilibrium controlled by successive determinations of density and by analysis. The Na₂CO₃ was determined by titration with 0.1 N HCl. The chlorate, by titration with excess of Mohr's salt and titrating with chromate (?).

d of sat. sol.	Gms. per 100 gms. H ₂ O.		Solid Phase.	d of sat. sol.	Gms. per 100 gms. H ₂ O.		Solid Phase.
	Na ₂ CO ₃ .	NaClO ₃ .			Na ₂ CO ₃ .	NaClO ₃ .	
1.224	28.5	0.0	Na ₂ CO ₃ · 10 H ₂ O	1.433	22.0	66.3	Na ₂ CO ₃ · 7 H ₂ O
1.236	26.8	5.2	"	1.439	22.5	66.5	"
1.250	25.9	10.7	"	1.443	21.8	69.3	"
1.274	24.7	16.1	"	1.443	22.2	69.4	"
1.277	25.1	16.4	"	1.440	22.1	69.8	"
1.293	24.3	20.7	"	1.442	21.4	71.0	" + Na
1.299	24.3	22.6	"	1.444	20.7	71.8	NaClO ₃
1.381	24.5	45.1	"	1.439	11.7	84.0	"
1.383	24.65	46.2	" + Na ₂ CO ₃ · 7 H ₂ O	1.431	5.3	91.8	"
1.391	24.8	47.3	Na ₂ CO ₃ · 7 H ₂ O	1.432	7.7	92.0	"
1.386	24.8	47.5	"	1.431	7.7	93.5	"
1.404	23.7	53.2	"	1.431	5.0	93.8	"
1.410	23.8	54.1	"	1.425	2.5	94.9	"
-	23.2	58.5	"	1.438	3.9	95.2	"
1.425	23.9	60.6	"	1.441	5.5	95.6	"
1.421	23.3	61.6	"	1.429	0.0	98.6	"
1.425	23.0	61.9	"	1.462	0.0	116.4	" (at 40°)
1.436	22.5	66.2	"	1.462	0.0	116.4	"

EQUILIBRIUM IN THE SYSTEM SODIUM CARBONATE, SODIUM
IODATE AND WATER.

(Foote and Vance, 1933.)

t°	Gms. per 100 gms. sat. sol.		Solid Phase	t°	Gms. per 100 gms. sat. sol.		Solid Phase
	NaIO ₃	Na ₂ CO ₃			NaIO ₃	Na ₂ CO ₃	
0	0.0	6.42	Na ₂ CO ₃ ·10H ₂ O	40	0.0	32.83	Na ₂ CO ₃ ·H ₂ O
"	0.82	6.29	" + NaIO ₃ ·5H ₂ O	"	0.50	32.68	"
"	2.42	0.0	NaIO ₃ ·5H ₂ O	"	1.79	32.04	" + NaIO ₃ ·H ₂ O
25	0.0	22.60	Na ₂ CO ₃ ·10H ₂ O	"	2.00	29.87	NaIO ₃ ·H ₂ O
"	0.52	22.44	"	"	11.71	0.0	"
"	2.16	22.22	" + NaIO ₃ ·H ₂ O	50	0.0	32.16	Na ₂ CO ₃ ·H ₂ O
"	2.54	18.82	NaIO ₃ ·H ₂ O	"	1.30	31.52	"
"	8.66	0.0	"	"	2.48	31.27	" + NaIO ₃ ·H ₂ O
				"	3.34	25.44	NaIO ₃ ·H ₂ O
				"	14.06	0.0	"

SOLUBILITY OF SODIUM CARBONATE IN AQUEOUS SOLUTIONS OF SODIUM NITRATE.
(Kremann and Zitek, 1909.)

t°.	Gms. per 100 Gms. H ₂ O.		Solid Phase.	t°.	Gms. per 100 Gms. H ₂ O.		Solid Phase.
	Na ₂ CO ₃	NaNO ₃			Na ₂ CO ₃	NaNO ₃	
10	11.98	0	Na ₂ CO ₃ ·10H ₂ O	24.2	24.63	54.43	Na ₂ CO ₃ ·7H ₂ O
10	8.75	70.48	" + NaNO ₃	24.2	21.8	62.7	" + NaNO ₃
10	0	80.5	NaNO ₃	24.2	5.96	84.45	NaNO ₃
24.2	28.55	0	Na ₂ CO ₃ ·10H ₂ O	24.2	0	91.3	"
24.2	26.33	45.96	" + Na ₂ CO ₃ ·7H ₂ O				

SOLUBILITY OF SODIUM BICARBONATE IN AQUEOUS SODIUM NITRATE
SOLUTIONS.

(Fedotieff and Koltunoff, 1914.)

t°.	Sp. Gr. of Sat. Sol.	Gms. per 100 Gms. H ₂ O.	
		NaNO ₃	NaHCO ₃
0	1.356	72.74	1.41
15	1.183	29.06	3.40
15	1.285	54.56	2.16
15	1.377	83.20	1.57
30	...	95.14	1.80

EQUILIBRIUM IN THE SYSTEM SODIUM CARBONATE, SODIUM
HYDROXIDE AND WATER AT TEMPERATURES ABOVE 150°.

(Schroeder, Berk and Gabriel, 1936.)

t°	Gms. per 100 gms. H ₂ O		t°	Gms. per 100 gms. H ₂ O	
	Na ₂ CO ₃	NaOH		Na ₂ CO ₃	NaOH
150	37.5	0.0	250	11.5	21.4
"	26.2	7.2	"	10.0	40.0
"	13.4	19.5	350	2.0	0.0
250	20.0	0.0	"	4.9	8.1
"	14.2	8.1	"	12.7	20.2

EQUILIBRIUM IN THE SYSTEM SODIUM CARBONATE, SODIUM HYDROXIDE

AND WATER. (Freeth, 1922.)

Saturation was secured by constant stirring in a thermostat. For the sodium hydroxide solutions silver bottles provided with mercury-sealed rotatory stirrers were used. The composition of the solid phases was determined by Schreinemaker's « rest method ». CO_2 was determined gravimetrically by absorption in KOH , Cl by the Volhard silver nitrate titration and sodium hydroxide titration with standard sulfuric acid solution.

t°.	Gms. per 100 gms. sat. sol.		Solid Phase.	t°.	Gms. per 100 gms. sat. sol.		Solid Phase.
	Na_2CO_3	NaOH			Na_2CO_3	NaOH	
0...	6.4	0.0	$\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$	20...	0.3	39.8	$\text{Na}_2\text{CO}_3 \cdot \text{H}_2\text{O}$
0...	2.6	8.1	"	20...	0.4	41.5	" + Na_2CO_3
0...	2.2	18.4	"	20...	5.4	43.9*	Na_2CO_3
0...	2.7	20.9	"	20...	9.6	43.8*	"
0...	3.1	22.3	" + $\text{Na}_2\text{CO}_3 \cdot 7\text{H}_2\text{O}$	20...	0.0	53.1	$\text{NaOH} \cdot \text{H}_2\text{O}$
0...	3.1	23.0	$\text{Na}_2\text{CO}_3 \cdot 7\text{H}_2\text{O}$	25...	22.7	0.0	$\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$
			+ $\text{Na}_2\text{CO}_3 \cdot \text{H}_2\text{O}$	25...	18.2	5.4*	"
0...	1.2	28.9	$\text{Na}_2\text{CO}_3 \cdot \text{H}_2\text{O}$	25...	18.1	7.0	"
0...	0.0	29.6	$\text{NaOH} \cdot 4\text{H}_2\text{O}$	25...	18.0	9.3	" + $\text{Na}_2\text{CO}_3 \cdot 7\text{H}_2\text{O}$
15...	14.1	0.0	$\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$	25...	21.0	5.8**	$\text{Na}_2\text{CO}_3 \cdot 7\text{H}_2\text{O}$
15...	10.1	4.8	"	25...	17.6	9.7	"
15...	7.5	13.8	"	25...	16.7	10.7	"
15...	8.9	17.0	" + $\text{Na}_2\text{CO}_3 \cdot 7\text{H}_2\text{O}$	25...	15.4	12.7	" + Na_2CO_3
15...	7.7	19.3	$\text{Na}_2\text{CO}_3 \cdot 7\text{H}_2\text{O}$	25...	1.2	30.6	$\text{Na}_2\text{CO}_3 \cdot \text{H}_2\text{O}$
15...	7.9	19.4	" + $\text{Na}_2\text{CO}_3 \cdot \text{H}_2\text{O}$	25...	0.5	37.5	"
15...	6.3	20.8	$\text{Na}_2\text{CO}_3 \cdot \text{H}_2\text{O}$	25...	0.5	42.4	" + Na_2CO_3
15...	4.1	23.9	"	25...	4.5	47.1*	Na_2CO_3
15...	1.2	30.6	"	25...	0.0	53.3	$\text{NaOH} \cdot \text{H}_2\text{O}$
15...	0.2	44.9	"	30...	28.4	0.0	$\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$
15...	0.6	47.3	" + Na_2CO_3	30...	26.5	4.1	"
15...	0.7	49.8	Na_2CO_3	30...	46.7	4.5	" + $\text{Na}_2\text{CO}_3 \cdot 7\text{H}_2\text{O}$
15...	0.0	51.2	$\text{NaOH} \cdot \text{H}_2\text{O}$	30...	25.7	4.0	$\text{Na}_2\text{CO}_3 \cdot 7\text{H}_2\text{O}$
15...	0.0	37.5	$\text{NaOH} \cdot 3\frac{1}{2}\text{H}_2\text{O}$	30...	24.4	5.5	"
15...	0.0	41.5	"	30...	21.9	7.9	" + Na_2CO_3
20...	18.0	0.0	$\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$	30...	19.0	9.8	$\text{Na}_2\text{CO}_3 \cdot \text{H}_2\text{O}$
20...	12.9	6.3	"	30...	13.7	11.8	"
20...	11.6	12.7	"	30...	0.9	11.2	"
20...	12.4	13.4	" + $\text{Na}_2\text{CO}_3 \cdot 7\text{H}_2\text{O}$	30...	15.1	35.0*	" + Na_2CO_3
20...	11.7	14.7	$\text{Na}_2\text{CO}_3 \cdot 7\text{H}_2\text{O}$	30...	0.5	41.6	"
20...	11.1	16.2	" + $\text{Na}_2\text{CO}_3 \cdot \text{H}_2\text{O}$	30...	2.5	44.5*	Na_2CO_3
20...	5.3	22.0	$\text{Na}_2\text{CO}_3 \cdot \text{H}_2\text{O}$	30...	6.1	49.1*	"
20...	1.1	29.7	"	30...	0.0	54.3	$\text{NaOH} \cdot \text{H}_2\text{O}$

* This solution was not clear.

** Supersaturated solution.

t°.	Gms. per 100 gms. sat. sol.		Solid Phase.	t°.	Gms. per 100 gms. sat. sol.		Solid Phase.
	Na_2CO_3	NaOH			Na_2CO_3	NaOH	
35...	32.9	0.0	$\text{Na}_2\text{CO}_3 \cdot 7\text{H}_2\text{O}$	45...	0.5	37.8	Na_2CO_3
35...	32.0	0.6	" + $\text{Na}_2\text{CO}_3 \cdot \text{H}_2\text{O}$	45...	0.5	38.3	"
35...	25.3	4.9	$\text{Na}_2\text{CO}_3 \cdot \text{H}_2\text{O}$	45...	0.5	47.0	Na_2CO_3
35...	15.2	11.9	"	45...	0.2	52.4	"
35...	7.5	18.7	"	45...	0.0	57.8	$\text{NaOH} \cdot \text{H}_2\text{O}$
35...	1.9	27.5	"	60...	31.8	0.0	Na_2CO_3
35...	0.5	34.2	"	60...	22.5	6.1	"
35...	0.5	39.2	" + Na_2CO_3	60...	14.2	12.2	"
35...	0.2	39.5	Na_2CO_3	60...	6.9	19.4	"
35...	0.2	44.8	"	60...	1.1	32.6	"
35...	0.2	50.2	"	60...	0.8	34.4	"
35...	0.0	55.4	$\text{NaOH} \cdot \text{H}_2\text{O}$	60...	0.7	35.4	Na_2CO_3
45...	32.2	0.0	$\text{Na}_2\text{CO}_3 \cdot \text{H}_2\text{O}$	60...	0.3	42.3	"

EQUILIBRIUM IN THE SYSTEM SODIUM CARBONATE, SODIUM
SULFATE AND WATER AT 25°. (Makarov and Jakimow, 1933.)

Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase
Na_2CO_3	Na_2SO_4		Na_2CO_3	Na_2SO_4	
22.94	0.0	$\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$	18.61	14.59	$\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$
21.77	3.76	"	18.28	16.38	" + $\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}$
21.05	6.01	"	15.14	16.64	$\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}$
19.60	10.03	"	9.11	18.12	"
18.87	12.75	"	3.54	20.20	"
			0.0	21.97	"

EQUILIBRIUM IN THE SYSTEM SODIUM BICARBONATE, SODIUM
SULFATE AND WATER AT 25°. (Makarov, and Jakimow, 1933.)

Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase
NaHCO_3	Na_2SO_4		NaHCO_3	Na_2SO_4	
9.39	0.0	NaHCO_3	4.16	20.68	$\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}$
5.75	9.87	"	3.77	20.80	"
6.03	11.14	"	0.0	21.90	"
4.14	20.58	" + $\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}$			

EQUILIBRIUM IN THE SYSTEM SODIUM CARBONATE, SODIUM SULFATE AND WATER
AT 19°.1 AND 50°. (Dawkins, 1922.)

The mixtures were constantly stirred in a thermostat. Both the saturated solutions and the undissolved residues were analyzed. The solid phase was mixed crystals in all cases.

At 19°.1

d of sat. sol.	Gms. per 100 gms. sat. sol.		Gms. per 100 gms. undissolved residue.	
	Na_2CO_3	Na_2SO_4	Na_2CO_3	Na_2SO_4
1.19	15.97	4.97	28.29	2.34
1.22	14.92	9.05	30.82	3.19
1.23	14.82	9.50	26.88	4.80
1.29	14.53	10.47	19.31	16.88
1.28	13.84	10.69	6.84	29.42
1.26	12.13	11.06	6.37	28.04
1.21	9.22	11.89	4.54	29.30
1.15	4.85	13.17	2.30	31.87

At 50°.

Gms. per 100 gms. sat. sol.	Gms. per 100 gms. undissolved residue.
Na_2CO_3	Na_2SO_4
28.64	5.35
28.52	5.87
25.71	7.52
19.37	12.92
12.55	20.35
10.52	22.47
10.21	23.10
5.06	27.31

EQUILIBRIUM IN THE SYSTEM SODIUM BICARBONATE, SODIUM SULFATE AND WATER.

Results at several temperatures.

(Nishizawa, 1920.)

t°.	Gm. mols. per 1000 gm. mols. H_2O .		Solid Phase.
	NaHCO_3	Na_2SO_4	
15.0...	18.53	0.0	NaHCO_3
15.0...	12.75	14.18	" + $\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}$
30.0...	23.61	0.0	NaHCO_3
30.0...	8.55	48.84	" + $\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}$
40.0...	26.92	0.0	NaHCO_3
40.0...	9.45	57.14	" + $\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}$

Results at 35°.

(Fedotieff and Kolossoff, 1923.)

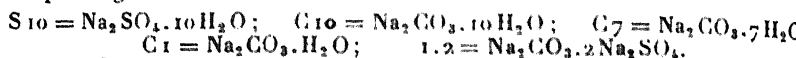
Gms. per 100 gms. H_2O .	Solid Phase.
NaHCO_3	Na_2SO_4
11.66	0.0
8.81	7.10
5.67	17.38
4.69	36.05
3.65	46.31

The following results are also given by Nishizawa, 1920, for solutions simultaneously saturated with sodium bicarbonate, sodium sulfate and the double salt, $1:1.4 = \text{Na}_2\text{SO}_4 \cdot (\text{NH}_4)_2\text{SO}_4 \cdot 4\text{H}_2\text{O}$.

t°.	Gms. mols. per 1000 gms. mols. H_2O .		Solid Phase.
	NaHCO_3	$(\text{NH}_4)_2\text{SO}_4$	
15.0	18.53	0.0	NaHCO_3
15.0	12.75	14.18	" + $\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}$
30.0	23.61	0.0	NaHCO_3
30.0	8.55	48.84	" + $\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}$
40.0	26.92	0.0	NaHCO_3
40.0	9.45	57.14	" + $\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}$

EQUILIBRIUM IN THE SYSTEM SODIUM CARBONATE, SODIUM SULFATE AND WATER AT VARIOUS TEMPERATURES. (Caspari, 1921.)

The mixtures were constantly rotated in a thermostat. Since the branches of the isotherms were nearly straight lines data are given only for the end points corresponding to the intersections.



t°.	Gms. per 100 gms. sat. sol.		Solid Phase.	t°.	Gms. per 100 gms. sat. sol.		Solid Phase.
	Na ₂ CO ₃	Na ₂ SO ₄			Na ₂ CO ₃	Na ₂ SO ₄	
-2.45.	5.21	2.06	C ₁₀ + S ₁₀ + Ice	30.0...	10.2	25.1	S ₁₀ + Na ₂
-2.1...	5.75	0.0	C ₁₀ + Ice	30.0...	0.0	29.3	"
15.0...	14.1	0.0	C ₁₀	31.0...	33.0	0.0	C ₇
15.0...	12.3	8.0	" + S ₁₀	35.0...	30.0	5.7	" + 1.2
15.0...	0.0	11.8	S ₁₀	35.0...	14.3	20.6	1.2 + Na ₂ S
20.0...	17.75	0.0	C ₁₀	35.0...	0.0	33.15	Na ₂ SO ₄
20.0...	14.95	11.2	" + S ₁₀	50.0...	32.2	0.0	C ₁
20.0...	0.0	16.25	S ₁₀	50.0...	29.7	5.5	" + 1.2
25.0...	22.6	0.0	C ₁₀	50.0...	11.4	22.2	1.2 + Na ₂ S
25.0...	17.9	16.2	" + S ₁₀	50.0...	0.0	31.8	Na ₂ SO ₄
25.0...	0.0	21.9	S ₁₀	75.0...	31.45	0.0	C ₁
30.0...	27.15	0.0	C ₁₀	75.0...	29.0	4.8	" + 1.2
30.0...	25.8	8.6	" + 1.2	75.0...	7.6	24.2	1.2 + Na ₂ S
30.0...	15.5	19.5	1.2 + Na ₂ SO ₄	75.0...	0.0	39.4	Na ₂ SO ₄

EQUILIBRIUM IN THE SYSTEM SODIUM CARBONATE, SODIUM SULFATE AND WATER AT TEMPERATURES UP TO 350°.

(Schroeder, Berk and Gabriel, 1936.)

CO

These experiments were made in connection with studies upon boiler-feed water.

Gms. per 100 gms. H ₂ O		Gms. per 100 gms. H ₂ O		Gms. per 100 gms. H ₂ O	
Na ₂ CO ₃	Na ₂ SO ₄	Na ₂ CO ₃	Na ₂ SO ₄	Na ₂ CO ₃	Na ₂ SO ₄
Results at 150°		Results at 250°		Results at 300° (con	
1.5	41.3	0.5	43.4	1.7	19.1
2.8	40.6	0.9	41.4	2.6	19.2
3.1	40.0	1.5	38.8	2.6	16.3
4.3	35.0	1.9	37.9	2.6	17.2
8.2	26.6	2.3	37.4	2.7	16.5
12.9	20.3	2.6	35.2	3.0	17.6
17.8	15.6	3.1	29.8	3.0	16.3
22.2	12.3	3.7	27.6	3.0	15.1
32.3	7.2	4.4	23.4	3.6	12.7
34.7	6.2	6.5	18.5	5.4	9.0
36.2	4.7	9.1	15.3	10.7	6.7
37.0	4.0	11.7	13.2	10.4	6.4
		14.0	11.9	10.7	4.0
		19.6	10.8	10.4	6.4
		21.1	10.0	10.7	4.0
		21.8	8.2	11.0	3.4
		22.7	7.9	9.4	1.7
		23.1	7.6		
		20.0	3.0	Results at 350°	
		20.4	3.0	0.2	2.5
				0.4	1.6
				0.8	1.9
		Results at 300°		2.1	1.2
		0.5	23.6	2.0	0.4
		1.2	21.1		
		1.4	20.6		

These results when plotted give curves with branches corresponding to solutions in contact with Na₂SO₄, a compound of Na₂SO₄ and Na₂CO₃.

SOLUBILITY OF SODIUM CARBONATE IN AQUEOUS SOLUTIONS OF ETHYL ALCOHOL.
(Ketner, 1901-02.)

NOTE. — The mixtures were so made that alcoholic and aqueous layers were formed, and these were brought into equilibrium with the solid phase.

t°.	Gms. per 100 Gms. Alcoholic Layer.			Gms. per 100 Gms. Aq. Layer.			Solid Phase.
	C ₂ H ₅ OH.	Na ₂ CO ₃ .	H ₂ O.	C ₂ H ₅ OH.	Na ₂ CO ₃ .	H ₂ O.	
35	62.9	0.3	36.8	1	32.4	66.6	Na ₂ CO ₃ ·H ₂ O
40	61	0.4	38.6	1.2	31.9	66.9	"
49	61	0.4	38.6	1.2	31.5	67.3	"
68	55.8	0.9	43.3	2.3	28.8	68.9	"
31.2	52.4	0.8	46.8	...	29.3	...	Na ₂ CO ₃ ·7H ₂ O (β)
31.9	54.8	0.7	44.5	1.7	29.8	68.5	"
32.3	56.1	0.6	43.3	1.5	30.2	68.3	"
33.2	58.1	0.5	42.4	1.4	31	67.6	"
27.7	Crit. sol. ± 14% C ₂ H ₅ OH ± 13% Na ₂ CO ₃ ± 73% H ₂ O						
28.2	23.5	7.3	69.2	7.9	18.6	73.5	Na ₂ CO ₃ ·10H ₂ O
29	32.7	3.8	63.5	4.3	22.7	73.0	"
29.7	40	2.1	57.9	2.9	25.5	71.6	"
30.6	47.8	1.2	51	2.3	27.8	69.9	"

SOLUBILITY OF Na₂CO₃·10H₂O IN DILUTE ALCOHOL AT 21°.
(Ketner.)

Gms. per 100 Gms. Solution.			Gms. per 100 Gms. Solution.		
Na ₂ CO ₃ .	C ₂ H ₅ OH.	H ₂ O.	Na ₂ CO ₃ .	C ₂ H ₅ OH.	H ₂ O.
18.5	0	81.5	1.2	39.2	59.6
12.7	6.2	81.1	0.2	58.2	41.6
6.9	15.3	77.8	0.1	67.1	32.8
3.2	26.1	70.7	0.06	73.3	26.64

Isotherms showing the compositions of the conjugated liquids at 28.2°, 29.7° and 40° are also given.

SOLUBILITY OF SODIUM CARBONATE IN AQUEOUS ETHYL ALCOHOL AT 30°.
(Cocheret, 1911.)

Gms. per 100 Gms. Sat. Sol.		Solid Phase.	Gms. per 100 Gms. Sat. Sol.		Solid Phase.
Na ₂ CO ₃ .	C ₂ H ₅ OH.		Na ₂ CO ₃ .	C ₂ H ₅ OH.	
26.61	2.64	Na ₂ CO ₃ ·10H ₂ O	0.40	63.20	Na ₂ CO ₃ ·7H ₂ O
26.14	3.41*	"	0.11	73.06	" + Na ₂ CO ₃ ·H ₂ O
1.38	44.81*	"	0.07	78.19	Na ₂ CO ₃ ·H ₂ O
0.62	52.99	"	0.06	90.95	"
0.53	55.70	" + Na ₂ CO ₃ ·7H ₂ O	0.03	95.06	" + Na ₂ CO ₃
0.51	56.56	Na ₂ CO ₃ ·7H ₂ O	...	98.46	Na ₂ CO ₃

* Between these two concentrations, the mixtures separate into two liquid layers.

Results are also given for the solubility of Na₂CO₃ + NaBr and of Na₂CO₃ + NaCl in Aq. C₂H₅OH at 30°.

SOLUBILITY OF SODIUM CARBONATE IN AQUEOUS SOLUTIONS OF ETHYL AND OF
PROPYL ALCOHOL AT 20°.
(Linebarger, 1892.)

Wt. Per cent Alcohol.	Gms. Na ₂ CO ₃ per 100 Gms. Sol.		Wt. Per cent Alcohol.	Gms. Na ₂ CO ₃ per 100 Gms. Sol.	
	In Ethyl.	In Propyl.		In Ethyl.	In Propyl.
28	...	4.4	48	0.9	1.3
38	...	2.7	50	0.84	1.2
44	1.7	1.7	54	0.80	0.9
46	1.13	1.5	62	...	0.4

EQUILIBRIUM IN THE SYSTEM SODIUM CARBONATE, NORMAL PROPYL ALCOHOL AND WATER AT 20°.

(Frankforter and Temple, 1915.)

(Note. In this paper the results for the binodal curve are reported in terms gms. per 100 gms. solvent (water + alcohol), instead of gms. per 100 gms. of the homogeneous liquid (sodium carbonate + water + alcohol.)

Gms. per 100 Gms. Alcohol + Water			Gms. per 100 Gms. Alcohol + Water.		
Na ₂ CO ₃	Alcohol.	Water.	Na ₂ CO ₃	Alcohol.	Water.
16.568	3.409	96.501	1.000	31.537	68.463
15.363	4.472	95.528	1.338	40.796	59.204
11.606	6.595	93.405	0.930	46.933	53.067
8.415	9.176	90.824	0.567	53.875	46.125
6.669	11.221	88.779	0.208	59.507	40.493
4.138	15.785	84.215	0.160	63.568	36.432
2.878	21.009	78.001	0.100	75.159	24.841

EQUILIBRIUM IN THE SYSTEM SODIUM CARBONATE, ISO PROPYL ALCOHOL AND WATER AT 25°.

(Ginnings and Chen, 1931.)

The results which were determined by the titration method locate binodal curve, a tie line, *, and the plait point, PP.

Gms. per 100 gms. of the three constituents		Gms. per 100 gms. of the three constituents	
Na ₂ CO ₃	iso Propyl Alcohol	Na ₂ CO ₃	iso Propyl Alcohol
0.10	63.5 *	11.70	8.96
0.91	47.6	14.50	5.61
2.34	35.8	17.11	3.24
6.54	19.34	19.18	2.15
6.3	19.9 PP	19.60	1.60 *
9.35	12.8		

EQUILIBRIUM IN THE SYSTEM SODIUM CARBONATE, TERTIARY BUTYL ALCOHOL AND WATER AT 30°.

(Ginnings and Robbins, 1930.)

The points on the binodal curve of this system were determined by observing the appearance or disappearance of clouding in a mixture of weighed amounts of Na₂CO₃ and one of the liquids upon addition of a weighed amount of the other. Tie lines, *, were located by determination of Na₂CO₃ in two liquid phases in contact with each other, and from these the plait point, PP, was found by plotting.

Gms. per 100 gms. of the 3 constituents		Gms. per 100 gms. of the 3 constituents		Gms. per 100 gms. of the 3 constituents	
Na ₂ CO ₃	(CH ₃) ₃ COH	Na ₂ CO ₃	(CH ₃) ₃ COH	Na ₂ CO ₃	(CH ₃) ₃ COH
—	97.0 *	3.3	22.4	9.7	6.8
—	70.0 *	4.0	19.7	10.4	6.1
—	55.0 *	4.5	—	11.2	5.2
0.7	52.3	4.6	18.1	12.9	4.0
1.0	50.0	5.0	16.6	14.1	3.1
1.3	41.3	5.4	15.3	15.1	3.1
1.8	35.4	6.0	11.9	16.0	2.5
2.0	35.0 PP.	7.2	9.9	18.9	1.5
2.1	30.8	7.7	—	25.2	0.6 *
2.8	26.2	8.0	8.6		

The plait point, PP, of the above system at 25° was found by Ginnings, Herring and Webb, 1933, to have the composition

2.1 gms. Na_2CO_3 + 32.2 gms. $(\text{CH}_3)_3\text{COH}$ + 35.7 gms. H_2O .

These authors also give the following composition of the plait point of the system, sodium potassium carbonate + tertiary butyl alcohol + water at 25°.

2.6 gms. NaKCO_3 + 31.6 gms. $(\text{CH}_3)_3\text{COH}$ + 35.8 gms. H_2O .

The remaining points on the binodal curves for these systems are not given but only the values of a series of arbitrary constants calculated from them by means of empirical equations.

For results on the system sodium carbonate, allyl alcohol, water at 20° see last table, p. 1245

100 gms. glycerol ($d_{15} = 1.256$) dissolve 98.3 gms. Na_2CO_3 at 15°-16°.

(Ossendowski, 1907.)

100 gms. saturated solution in glycol contain 3.28-3.4 gms. sodium carbonate.

(de Coninck, 1905.)

100 gms. H_2O dissolve 229.2 gms. sugar + 24.4 gms. Na_2CO_3 , or 100 gms. sat. aq. solution contain 64.73 gms. sugar + 6.89 gms. Na_2CO_3 at 31.25°.

(Köhler, 1897.)

SOLUBILITY OF SODIUM CARBONATE AND OF SODIUM BICARBONATE
(EACH SEPARATELY) IN GLYCEROL AT 20°. (Holm, 1921, 1922.)

Solvent.	Gms. Na_2CO_3 per 100 gms. solvent.	Gms. NaHCO_3 per 100 gms. solvent.
86.5 % glycerol of $d = 1.2326$	108-113	4.05
98.5 % " " $d = 1.2645$	78-102	7.86

EQUILIBRIUM IN THE SYSTEM SODIUM CARBONATE, PYRIDINE, WATER.

(Limbosch, 1909.)

Very pure materials were used. The boiling-point (cor.) of the pyridine was 115°-115.07°. Increasing amounts of this pyridine were added to aqueous solutions of sodium carbonate contained in glass tubes. After the tubes were sealed they were placed in a bath and the temperature noted at which the liquid mixture passed from a homogeneous to an opalescent condition. During the observation, the contents of the tubes were stirred by means of pieces of iron, moved with the aid of a magnet on the outside of the tube.

Per cent of Na_2CO_3 .	Per cent of Pyridine.	t° of Sat.	Per cent of Na_2CO_3 .	Per cent of Pyridine.	t° of Sat.	Per cent of Na_2CO_3 .	Per cent of Pyridine.	t° of Sat.
0.129	66.2	12	2.50	50	190	6.12	23.5	120
0.129	66.4	25	2.50	53.3	197	6.12	25.5	132
0.129	67.7	36	2.50	59.4	173	6.12	28.4	152
0.129	69.2	44	2.50	69.2	123	6.99	13.8	54.2(40.5)
0.129	73.5	53	2.50	73.8	110	6.99	15.4	81 (17)
0.129	74.8	51.5	2.50	74.8	*	6.99	19.5	117
0.129	76.1	25.5(-64)	3.49	30.3	-0.5	6.99	22.7	142
0.129	77.8	11 (-59)	3.49	32.6	39	6.99	25.1	158
1.01	47.6	17	3.49	34.3	86.5	6.99	27.6	169
1.01	49.9	36	3.49	36.7	107	6.99	32.6	180+
1.01	51.2	55	3.49	37.4	123	9.36	8.50	64 (26)
1.01	52.2	72	3.49	42.5	194	9.36	9	78 (18)
1.01	56.1	107	3.49	69.6	757	9.36	11.4	106.5
1.01	60.6	111	3.49	71.2	*	9.36	13.8	127
1.01	66.8	110	5.23	23.3	63(27.5)	9.36	16.3	148
1.01	75.1	86.5	5.23	23.7	70(20.5)	9.36	20.1	169
1.01	76.9	71	5.23	24.6	79	9.36	25	180+
1.01	78.1	*	5.23	26.2	96	9.36	50	180+
2.50	36.3	22	5.23	28.7	111	18.1	2.12	48 (18)
2.50	37.9	53.25	5.23	32.5	155	18.1	2.25	66
2.50	39.2	74.5	5.23	36.6	196	18.1	2.70	79
2.50	40	94	5.23	37.2	200+	18.1	4.20	108
2.50	43.6	147	5.23	55.4	*	18.1	5.40	126
2.50	47.6	185				18.1	6.80	155

* Precipitate of Na_2CO_3 . Results in parentheses show lower temperatures of saturation.

The binodal curve and plait point of the system Sodium Carbonate + Pyridine + Water at 25° has been determined by Ginnings, Webb and Hinohara, 1933, but the authors do not give their experimental results but only the values of a series of arbitrary constants calculated from them by means of empirical equations.

Fusion-point data for $\text{Na}_2\text{CO}_3 + \text{NaCl}$ are given by Le Chatelier (1894) and Sackur (1911-12). Results for $\text{Na}_2\text{CO}_3 + \text{Na}_2\text{SO}_4$ are given by Le Chatelier (1894), Sackur (1911-12) and by Amadori (1912). Results for $\text{Na}_2\text{CO}_3 + \text{KCl}$ are given by Sackur (1911-12).

CO

SODIUM Campho CARBONATE $\text{C}_{10}\text{H}_{16}\text{O} \cdot \text{COONa}$.

SOLUBILITY OF SODIUM CAMPHO CARBONATE IN SEVERAL SOLVENTS AT 7°.
(Picon, 1921.)

Solvent	Formula	Gms. $\text{C}_{10}\text{H}_{16}\text{O} \cdot \text{COONa}$ per liter sat. solution
Water	H_2O	123.2
Methyl Alcohol	CH_3OH	284.7
Ethyl Alcohol	$\text{C}_2\text{H}_5\text{OH}$	15.36
Chloroform	CHCl_3	17.18

SODIUM Thio CARBONATE Na_2CS_3 .

100 gms. Ethyl Alcohol of $d = 0.941$ dissolve 4.55 gms. Na_2CS_3 at 15.5°.

SODIUM OXALATE $\text{Na}_2(\text{COO})_2$.

COO

SOLUBILITY OF SODIUM OXALATE IN WATER.

The results of Flöttmann, 1928; Foote and Vance, 1933(a); Boulange 1936; and of Britton and Jarret, 1936(a), were plotted and the following values taken from the average curve.

t°	Gms. $\text{Na}_2\text{C}_2\text{O}_4$ per 100 gms. sat. sol.	t°	Gms. $\text{Na}_2\text{C}_2\text{O}_4$ per 100 gms. sat. sol.
0	2.62	40	4.01
10	2.96	50	4.37
15 ($d = 1.0251$)	3.11	60	4.70
20 ($d = 1.0255$)	3.40	70	5.05
25 ($d = 1.0254$)	3.48	80	5.40
30	3.67	100	6.10

SOLUBILITY OF MIXTURES OF SODIUM OXALATE AND OXALIC ACID IN
WATER AT 25°. (Foote and Andrew, 1905.)

Gms. per 100 Gms. Solution.		Mols. per 100 Mols. H ₂ O.		Solid Phase.
H ₂ C ₂ O ₄ .	Na ₂ C ₂ O ₄ .	H ₂ C ₂ O ₄ .	Na ₂ C ₂ O ₄ .	
10.20	...	2.274	...	H ₂ C ₂ O ₄ ·2H ₂ O
10.50	0.83	2.370	0.130	H ₂ C ₂ O ₄ ·2H ₂ O + HNaC ₂ O ₄ ·H ₂ O
9.15	0.71	2.032	0.106	
6.88	0.86	1.493	0.125	Double Salt, HNaC ₂ O ₄ ·H ₂ O
1.14	1.25	0.234	0.172	
0.47	3.20	0.098	0.446	
0.42	3.85	0.090	0.541	HNaC ₂ O ₄ ·H ₂ O + Na ₂ C ₂ O ₄
...	3.60	...	0.502	Na ₂ C ₂ O ₄

SOLUBILITY OF MIXTURES OF SODIUM OXALATE AND OTHER SODIUM SALTS
IN WATER AT 15° AND AT 50°. (Colani, 1916.)

t°.	Gms. per 100 Gms. Sat. Solution.		Solid Phase.
	Na ₂ C ₂ O ₄	NaCl	
15	0.027	+ 26.28	Na ₂ C ₂ O ₄ + NaCl
50	0.063	+ 26.64	" + "
15	0.86	+ 10.26	Na ₂ C ₂ O ₄ + Na ₂ SO ₄ ·10H ₂ O
50	0.22	+ 31.95	" + Na ₂ SO ₄
15	0.051	+ 45.86	Na ₂ C ₂ O ₄ + NaNO ₃
50	0.047	+ 53.06	" + "

Data for equilibrium in the quarternary system

COO

Na₂C₂O₄ + H₂SO₄ (or H₂C₂O₄) + Na₂SO₄ + H₂O at 24.71° are given by Elöd and Acker, 1938. The available results for the ternary systems were used and especial attention given to the determination of the mono variant points of the quarternary system. The results are expressed according to the Jänecke method in terms of gram molecules of H₂O to dissolve one gm. mol. of salt mixture of determined composition.

EQUILIBRIUM IN THE SYSTEM SODIUM OXALATE, URANYL OXALATE AND
WATER AT 15° AND 50°. (Colani, 1917.)

Results at 15°.			Results at 50°.		
Gms. per 100 Gms. Sat. Sol.		Solid Phase.	Gms. per 100 Gms. Sat. Sol.		Solid Phase.
Na ₂ C ₂ O ₄ .	UO ₂ C ₂ O ₄ .		Na ₂ C ₂ O ₄ .	UO ₂ C ₂ O ₄ .	
3.09	0	Na ₂ C ₂ O ₄	4.28	0	Na ₂ C ₂ O ₄
4.93	3.14	" + 2.1.2.5	9.03	13.69	" + 2.1.2.5
1.80	5.01	2.1.2.5 + 2.4.5.11	4.62	12.33	2.1.2.5 + 2.2.3.5
0.80	2.65	2.4.5.11 + UO ₂ C ₂ O ₄ ·3H ₂ O	3.60	9.84	2.2.3.5 + 2.4.5.11
0	0.47	UO ₂ C ₂ O ₄ ·3H ₂ O	1.01	3.58	2.4.5.11 + UO ₂ C ₂ O ₄ ·3H ₂ O
			0	1	UO ₂ C ₂ O ₄ ·3H ₂ O

2.1.2.5 = Na₂(UO₂)(C₂O₄)₂·5H₂O, 2.2.3.5 = Na₂(UO₂)₂(C₂O₄)₃·5H₂O, 2.4.5.11 = Na₂(UO₂)₄(C₂O₄)₅·11H₂O.

Na NATRIUM SODIUM OXALATE

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EQUILIBRIUM IN THE SYSTEM SODIUM OXALATE, SODIUM IODATE AND WATER.

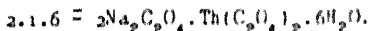
(Foote and Vance, 1933a.)

Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase
NaIO_3	$\text{Na}_2\text{C}_2\text{O}_4$		NaIO_3	$\text{Na}_2\text{C}_2\text{O}_4$	
Results at 0°			Results at 25°		
0.0	2.62	$\text{Na}_2\text{C}_2\text{O}_4$	0.0	3.56	$\text{Na}_2\text{C}_2\text{O}_4$
1.16	2.46	" + $\text{NaIO}_3 \cdot 5\text{H}_2\text{O}$	4.28	3.01	"
2.42	0.0	$\text{NaIO}_3 \cdot 5\text{H}_2\text{O}$	6.43	2.41	" + $\text{NaIO}_3 \cdot \text{H}_2\text{O}$
			8.66	0.0	$\text{NaIO}_3 \cdot \text{H}_2\text{O}$
Results at 40°			Results at 50°		
0.0	4.09	$\text{Na}_2\text{C}_2\text{O}_4$	0.0	4.37	$\text{Na}_2\text{C}_2\text{O}_4$
5.63	2.98	"	9.26	2.70	"
9.31	2.38	" + $\text{NaIO}_3 \cdot \text{H}_2\text{O}$	11.67	2.31	" + $\text{NaIO}_3 \cdot 5\text{H}_2\text{O}$
10.26	1.25	$\text{NaIO}_3 \cdot \text{H}_2\text{O}$	12.69	1.13	$\text{NaIO}_3 \cdot 5\text{H}_2\text{O}$
11.71	0.0	"	14.06	0.0	"

EQUILIBRIUM IN THE SYSTEM SODIUM OXALATE, THORIUM OXALATE AND WATER AT 25°.

(Britton and Jarrett, 1936a.)

COO	Gm. Mols. per liter sat. sol.		Solid Phase	Gm. Mols. per liter sat. sol.		Solid Phase
	$\text{Na}_2\text{C}_2\text{O}_4$	$\text{Th}(\text{C}_2\text{O}_4)_2$		$\text{Na}_2\text{C}_2\text{O}_4$	$\text{Th}(\text{C}_2\text{O}_4)_2$	
	0.2670	0.0	$\text{Na}_2\text{C}_2\text{O}_4$	0.1945	0.04430	2.1.6
	0.2672	0.00361	"	0.1679	0.05128	" + $\text{Th}(\text{C}_2\text{O}_4)_2$
	0.2793	0.01166	"	0.1408	0.04634	$\text{Th}(\text{C}_2\text{O}_4)_2 \cdot 6\text{H}_2\text{O}$
	0.3022	0.03036	"	0.09158	0.04051	"
	0.3110	0.03490	"	0.07554	0.02998	"
	0.3184	0.03900	" + 2.1.6	0.05520	0.01550	"
	0.3257	0.04543	2.1.6	0.04819	0.01318	"
	0.3879	0.03852	"	0.03844	0.009055	"
	0.2281	0.03920	"	0.02005	0.002762	"
				0.01002	0.000901	"



EQUILIBRIUM IN THE SYSTEM SODIUM OXALATE, ZINC OXALATE AND WATER AT 18°.

(Britton and Jarrett, 1936c.)

Gm. Mols. per liter sat. sol.		Solid Phase	Gm. Mols. per liter sat. sol.		Solid Phase
$\text{Na}_2\text{C}_2\text{O}_4$	ZnC_2O_4		$\text{Na}_2\text{C}_2\text{O}_4$	ZnC_2O_4	
0.240	0.000	$\text{Na}_2\text{C}_2\text{O}_4$	0.100	0.0052	$\text{ZnC}_2\text{O}_4 \cdot 2\text{H}_2\text{O}$
0.254	0.0133	"	0.080	0.00326	"
0.262	0.0250	"	0.060	0.00191	"
0.273	0.0337	"	0.040	0.00110	"
0.245	0.0335	$\text{ZnC}_2\text{O}_4 \cdot 2\text{H}_2\text{O}$	0.020	0.00055	"
0.224	0.0275	"	0.010	0.00026	"
0.200	0.0217	"	0.000	—	"
0.150	0.0120	"			

EQUILIBRIUM IN THE SYSTEM SODIUM OXALATE, ZIRCONIUM
OXALATE AND WATER.

(Boulangier, 1936.)

Results at 39°

Results at 52°

Gms. per 100 gms. sat. sol.		Gms. per 100 gms. sat. sol.		Solid Phase at each Temp.
$\text{Na}_2\text{C}_2\text{O}_4$	ZrOC_2O_4	$\text{Na}_2\text{C}_2\text{O}_4$	ZrOC_2O_4	
4.0	0.0	4.40	0.0	$\text{Na}_2\text{C}_2\text{O}_4$
4.20	0.07	4.59	0.20	"
4.22	0.20	5.13	0.29	"
4.23	0.41	4.98	0.54	"
4.62	0.66	5.00	0.90	$\text{Na}_2\text{C}_2\text{O}_4 \cdot \text{ZrOC}_2\text{O}_4 \cdot \text{H}_2\text{C}_2\text{O}_4 \cdot 2\text{H}_2\text{O} (?)$
4.80	0.66	5.14	0.99	"
4.50	0.64	5.19	1.12	"
4.41	0.63	5.20	1.14	"
4.31	0.77	5.34	1.36	"
4.21	0.82	5.29	1.40	"
3.95	0.99	5.00	1.30	Unfilterable gel
3.67	1.31	4.95	1.72	"
3.30	1.15	3.86	1.50	"

100 gms. 95% formic acid dissolves 8.8 gms. $\text{Na}_2\text{C}_2\text{O}_4$ at 19.3°.
(Aschan, 1913.)

SODIUM Bi OXALATE $\text{Na}_2\text{C}_2\text{O}_4 \cdot \text{H}_2\text{C}_2\text{O}_4 \cdot 2\text{H}_2\text{O}$.SOLUBILITY OF SODIUM BIOXALATE IN AQUEOUS SOLUTIONS OF
HYDROCHLORIC ACID AT 20°.

(Trapp, 1935.)

Gms. per 100 gms. sat. solution		Solid Phase
HCl	$\text{Na}_2\text{C}_2\text{O}_4 \cdot \text{H}_2\text{C}_2\text{O}_4 \cdot 2\text{H}_2\text{O}$	
0.0	1.86	$\text{Na}_2\text{C}_2\text{O}_4 \cdot \text{H}_2\text{C}_2\text{O}_4 \cdot 2\text{H}_2\text{O}$
2.90	4.32	"
6.47	5.80	"
9.56	5.97	"

SODIUM CHLORIDE NaCl

SOLUBILITY IN WATER.

(Mulder; de Coppet, 1883; Andr , 1884; Raupenstrauch, 1885; above 100°, Tilden and Shenstone,
1884; Berkeley, 1904; Etard, 1894, gives irregular results.)

t°.	Gms. NaCl per 100 Gms. H ₂ O.		Gms. NaCl per 100 g. Sol.	t°.	Gms. NaCl per 100 Gms. H ₂ O.		Gms. NaCl per 100 g. Sol.
0	35.7*	35.63†	26.28†	70	37.8*	37.51†	27.27†
10	35.8	35.69	26.29	80	38.4	38.00	27.54
20	36.0	35.82	26.37	90	39.0	38.52†	27.80
25	36.12	35.92	26.43	100	39.8	39.12†	28.12
30	36.3	36.03	26.49	118		39.8	28.46
40	36.6	36.32	26.65	140		42.1	29.63
50	37.0	36.67	26.83	160		43.6	30.37
60	37.3	37.06	27.04	180		44.9	30.98

* M.; de C.

† A.

‡ B.

The original, very carefully determined figures of Berkeley, are as follows:

t°.	d of Sat. Sol.	Gms. NaCl per 100 Gms. H ₂ O.	t°.	d of Sat. Sol.	Gms. NaCl per 100 Gms. H ₂ O.
0.35	1.2090	35.75	61.70	1.1823	37.28
15.20	1.2020	35.84	75.65	1.1764	37.82
30.05	1.1956	36.20	90.50	1.1701	38.53
45.40	1.1891	36.60	107 b. pt.	1.1631	39.65

100 gms. H₂O dissolve 35.99 gms. NaCl at 30°.

(Cocheret, 1911.)

SOLUBILITY OF SODIUM CHLORIDE IN WATER, DETERMINED BY THE FREEZING-POINT METHOD.
(Matignon, 1909a.)

t°.	Gms. NaCl per 100 Gms. H ₂ O.	Solid Phase.	t°.	Gms. NaCl per 100 Gms. H ₂ O.	Solid Phase.
-0.4	0.69	Ice (Raoult)	-12.7	20	Ice
-0.8	1.37	" (Biltz)	-16.66	25	"
-2.86	4.9	" (Kahlenberg)	-21.3	30.7	" + NaCl.2H ₂ O
-3.42	5.85	" (Raoult)	-14	32.5	NaCl.2H ₂ O (de Coppet)
-6.6	11	"	-12.25	32.9	" (Matignon)
-9.25	15	"	-6.25	34.22	" (de Coppet)

C1

THE ICE CURVE FOR AQUEOUS SOLUTIONS OF SODIUM CHLORIDE.
(Rodebush, 1918.)

The temperatures were measured with a thermoelement and the concentrations determined by conductivity.

t° of f. pt.	Gms. NaCl per 100 gms. H ₂ O.	t° of f. pt.	Gms. NaCl per 100 gms. H ₂ O	t° of f. pt.	Gms. NaCl per 100 gms. H ₂ O
-3.48.....	6.11	-9.41....	15.46	-16.21.....	24.75
-5.17.....	8.92	-11.04....	17.87	-18.73.....	27.70
-6.32.....	10.77	-14.33....	22.25	-20.56.....	29.70
-8.52.....	14.20	-14.77....	22.99	-21.12 Eutec..	30.40

Similar determinations by Klein and Svanberg, 1920, gave the following results.

t° of f. pt.		-0.310.	-0.833.	-1.688.
Normality of aq NaCl.....	0.1	0.25	0.5	

More recent determinations of Cornec and Krombach, 1932; Iljinski and Sagaidotschny, 1931; Küpper, 1927; Wright, 1927; Scott and Frazier, 1927; Cornec and Neumeister, 1929; Gerassimow, 1930; and Flöttmann, 1928; give an average curve from which the following results were taken.

t°	Gms. NaCl per 100 gms. sat. sol.	Solid Phase	t°	Gms. NaCl per 100 gms. sat. sol.	Solid Phase
-21.1	23.0	Ice + NaCl.2H ₂ O	20 (d=1.2001)	26.40	NaCl
-15	24.25	NaCl.2H ₂ O	25 (d=1.19796)	26.406	"
-10	25.0	"	25 (d=1.1979)	26.47	"
-5	25.6	"	30	26.52	"
+ 0.1	26.3	" + NaCl	40	26.67	"
10.0	26.34	"	60	27.07	"
15.0 (d=1.2024)	26.34	"	80	27.55	"
			100	28.15	"

SODIUM CHLORIDE

SOLUBILITY OF SODIUM CHLORIDE IN WATER AT TEMPERATURE ABOVE 100°.

The results of Cornec and Krombach, 1932; Achumow and Wassiljew, 1932; Froehlich, 1929; and Benrath, Gjedebø, Schiffers and Wunderlich, 1937, were plotted and the following values taken from the average curve.

t°	Gms. NaCl per 100 gms. sat. sol.	t°	Gms. NaCl per 100 gms. sat. sol.	t°	Gms. NaCl per 100 gms. sat. sol.
100	28.4	250	34.0(34.2)	400	46.4
150	29.7(29.6)	300	37.2(37.5)	450	50.8
200	31.6(31.6)	350	41.7(42.0)		

The results in parentheses are by Schroeder, Gabriel and Partridge, 1935.

Results for the Solubility of Sodium Chloride in Water at 30° under pressures up to 4000 bars (metric atmospheres) are given by Adams and Hale, 1931. Measurements of the volume changes at pressures up to 12,000 bars for aqueous sodium chloride solutions ranging from 0 to 25 weight percent concentration, are given by Adams, 1931. Other results for the influence of pressure upon the solubility of sodium chloride in water are given by v. Stackelberg, 1896; Cohen, Inouye and Euwen, 1910, and by Sill, 1916.

Cl

RELATIVE SOLUBILITY OF SODIUM CHLORIDE IN ORDINARY WATER AND IN HEAVY WATER ($\text{H}_2\text{H}_2\text{O}$).

(Taylor, Caby and Eyring, 1933.)

t°	Gms. NaCl per 100 gms.
	Ordinary H_2O Water containing 92% $\text{H}_2\text{H}_2\text{O}$
25	35.9 30.5

SOLUBILITY OF SODIUM CHLORIDE IN AQUEOUS SOLUTIONS SIMULTANEOUSLY SATURATED WITH OTHER SALTS.

The various papers of J. H. van't Hoff and collaborators, on this subject, have been collected by H. Precht and E. Cohn in a volume entitled "Untersuchungen über die Bildungsverhältnisse die Ozeanischen Salzablagerungen," Leipzig, 1912, p. 374. By far the larger part of the new data in these papers are for solutions simultaneously saturated with three or more salts and are, therefore, beyond the limits of complexity of mixture, set for the present volume. The various systems are described in detail and diagrams are given. A table summarizing much of the data (van't Hoff (1905)) is given on the following page.

SOLUBILITY OF SODIUM CHLORIDE IN AQUEOUS SOLUTIONS SIMULTANEOUSLY SATURATED WITH OTHER SALTS AT 25°.

(van't Hoff, 1905.)

Mols. per 1000 Mols. H ₂ O.					Solution Saturated with Respect to NaCl and:
Na ₂ Cl ₂ .	K ₂ Cl ₂ .	MgCl ₂ .	MgSO ₄ .	Na ₂ SO ₄ .	
1	0.5	105	...	...	MgCl ₂ .6H ₂ O + Carnallite
2	5.5	70.5	...	...	KCl + Carnallite
44	20	...	...	4.5	" + Glaserite
44	10.5	...	...	14.5	Na ₂ SO ₄ + "
46	...	...	16.5	3.0	" + Astrakanite
26	...	7	34	...	MgSO ₄ .7H ₂ O + Astrakanite
4	...	67.5	12	...	" + MgSO ₄ .6H ₂ O
2.5	...	79	9.5	...	Kieserite + "
1	...	101	5	...	" + MgCl ₂ .6H ₂ O
23	14	21.5	14	...	KCl + Glaserite + Schönite
19.5	14.5	25.5	14.5	...	" + Leonite + "
9.5	9.5	47	14.5	...	" + " + Kainite
2.5	6	68	5	...	" + Carnallite + "
1	1	85.5	8	...	Kieserite + Carnallite + Kainite
42	8	...	16	6	Na ₂ SO ₄ + Glaserite + Astrakanite
27.5	10.5	16.5	18.5	...	Schönite + Glaserite + Astrakanite
22	10.5	23	19	...	Leonite + Glaserite + Astrakanite
10.5	7.5	42	19	...	" + MgSO ₄ .7H ₂ O + Astrakanite
9	7.5	45	19.5	...	" + " + Kainite
3.5	4	65.5	13	...	MgSO ₄ .6H ₂ O + " + "
1.5	2	77	10	...	MgSO ₄ .6H ₂ O + Kieserite + "
1	0.5	100	5	...	Carnallite + MgCl ₂ .6H ₂ O + "
1	0.5	105	...	...	MgCl ₂ .6H ₂ O + Carnallite
2	5.5	70.5	...	...	KCl + "
			CaCl ₂ .		
1	...	51.5	90.5	...	MgCl ₂ .6H ₂ O + Tachhydrite
1	11	...	146	...	KCl + CaCl ₂ .6H ₂ O
1	...	35.5	121.5	...	Tachhydrite + CaCl ₂ .6H ₂ O
1	1.5	50.5	90.5	...	MgCl ₂ .6H ₂ O + Tachhydrite + Carnallite
1	9.5	5	141.5	...	CaCl ₂ .6H ₂ O + KCl + Carnallite
1	2	34.5	121.5	...	CaCl ₂ .6H ₂ O + Tachhydrite + Carnallite

Carnallite = KMgCl₂.6H₂O, Glaserite = K₃Na(SO₄)₂, Astrakanite = Na₂Mg(SO₄)₂.4H₂O, Kieserite = MgSO₄.H₂O, Leonite = MgK₂(SO₄)₂.4H₂O, Schönite = MgK₂(SO₄)₂.6H₂O, Kainite = MgSO₄.KCl.3H₂O.

SOLUBILITY OF SODIUM CHLORIDE IN AQUEOUS CALCIUM CHLORIDE SOLUTIONS AT 25°.

(Mills and Wells, 1918.)

<i>d</i> ₂₅ of Sat. Sol.	Gms. per 100 Gms. Sat. Sol.		<i>d</i> ₂₅ of Sat. Sol.	Gms. per 100 Gms. Sat. Sol.	
	CaCl ₂ .	NaCl.		CaCl ₂ .	NaCl.
1.207	1.103	25.30	1.225	9.50	17.55
1.210	2.160	24.32	1.233	11.48	15.91
1.209	3.220	23.37	1.241	17.77	10.54
1.216	5.451	20.43	1.257	21	8.05
1.220	7.398	19.17	1.276	24.58	5.63

SODIUM CHLORIDE

SOLUBILITY OF SODIUM CHLORIDE IN AQUEOUS SOLUTIONS OF
HYDROCHLORIC ACID AT 18°.

(Fricke and Brummer, 1935.)

d. of sat. sol.	Gms. Mols. per 1000 gms. sat. sol.		d. of sat. sol.	Gms. Mols. per 1000 gms. sat. sol.	
	HCl	NaCl		HCl	NaCl
1.2005	0.0	4.513	1.188	0.3610	4.151
1.199	0.0438	4.474	1.173	0.9263	3.605
1.197	0.0870	4.433	1.155	1.6677	2.889
1.194	0.1756	4.346	1.136	2.6740	2.055
			1.124	3.5670	1.408

SOLUBILITY OF SODIUM CHLORIDE IN AQUEOUS SOLUTIONS OF HYDRO-
CHLORIC ACID.

(Engel, 1888; Enklaar, 1901.)

At 0°. (Engel.)					Mols. At 10°-10.5°. (Enklaar.)				
Mg. Mols. per 10 cc.		Sp. Gr. of Solution.	Gms. per 100 cc.		per 1000 gms. H ₂ O		Gms. per 100 gms. H ₂ O		
HCl.	NaCl.		HCl.	NaCl.	HCl.	NaCl.	HCl.	NaCl.	
0.0	54.7	1.207	0.0	32.0	0.0	6.11	0.0	35.77	
1.0	53.5	1.204	0.365	31.3	0.27	5.77	9.84	33.76	
1.85	52.2	1.202	0.674	30.5	0.35	5.67	12.76	33.19	
5.1	48.5	1.196	1.859	28.4	0.43	5.59	15.68	32.71	
9.28	44.0	1.185	3.38	25.7	0.57	5.43	20.78	31.77	
15.05	37.9	1.173	5.49	22.2	0.72	5.28	26.06	30.89	
30.75	23.5	1.141	11.20	13.7	2.60	3.42	94.77	20.01	
56.35	6.1	1.119	20.54	3.6	2.80	3.18	102.1	19.04	
					3.31	2.74	120.6	16.03	

Cl

Results at 0° and at 25°.
(Armstrong and Eyre, 1910-11.)

Gms. HCl per Liter of Solvent.	Gms. NaCl per 100 Gms. Sat. Sol.	
	At 0°.	At 25°.
0	26.35	26.52 ($d_{25} = 1.2018$)
9.11	25.30	25.45 ($d_{25} = 1.1970$)
18.22	24.15	25.42 ($d_{25} = 1.1915$)
36.45	21.93	22.34 ($d_{25} = 1.1822$)
182.25	...	7.04 ($d_{25} = 1.1238$)

Results at 25°. Results at 30°.
(Herz, 1911-12.) (Schreinemakers, 1909-10.)

Mols. per Liter.		Gms. per 100 Gms. Sat. Sol.	
HCl.	NaCl.	HCl.	NaCl.
0.607	4.850	0	26.47
1.032	4.467	6.93	16.16
1.590	3.782	12.50	9.35
2.117	3.297	17.35	4.52
3.283	2.343	35.60	0.11

Results at 30°. (Masson, 1911.)

Gm. Mols. per Liter.		Gm. Mols. per Liter.	
HCl.	NaCl.	HCl.	NaCl.
0	5.400	1.1427	3.052
0.4575	4.932	1.1289	4.152
0.969	4.386	1.1188	5.950
1.1633	3.589	1.1258	7.205
2.412	2.978		

In the case of the results of Masson equilibrium was approached from above and the solutions were kept in a thermostat and shaken occasionally during 2-6 days.

SOLUBILITY OF SODIUM CHLORIDE IN AQUEOUS SOLUTIONS OF
HYDROCHLORIC ACID AT 25°.

(Ingham, 1928.)

d. of sat. sol.	Gm. Mols. per liter sat. sol.		d. of sat. sol.	Gm. Mols. per 1000 gms. sat. sol.	
	HCl	NaCl		HCl	NaCl
1.1981	0.0	5.4325	1.1200	4.500	1.333
1.1867	0.503	4.880	1.1160	5.253	0.907
1.1781	0.886	4.483	1.1158	6.101	0.544
1.1511	2.265	3.149	1.1213	7.073	0.293
1.1352	3.185	2.310	1.1302	7.976	0.158
1.1319	3.487	2.079	1.1458	9.236	0.091
1.1282	3.830	1.797	1.1970	13.41	0.017

The author also gives the viscosities of the saturated solutions.

SOLUBILITY OF SODIUM CHLORIDE IN AQUEOUS ETHYL ALCOHOL
SOLUTIONS OF HYDROCHLORIC ACID AT 25°.

(Akerlof, Teare and Turck, 1937.)

Gm. Mols. HCl per 1000 gms. solvent	Gm. Mols. NaCl per 1000 gms. solvent containing:					
	0% C ₂ H ₅ OH	10% C ₂ H ₅ OH	20% C ₂ H ₅ OH	30% C ₂ H ₅ OH	40% C ₂ H ₅ OH	50% C ₂ H ₅ OH
C1	0.0	6.162	5.104	4.133	3.282	2.543
	0.1	6.058	4.983	4.039	3.221	2.474
	0.2	5.951	4.866	3.959	3.112	2.383
	0.3	5.846	4.767	3.856	3.032	2.295
	0.5	5.631	4.574	3.702	2.858	2.144
	0.75	5.361	4.325	3.435	2.645	1.957
	1.0	5.096	4.082	3.213	2.454	1.780
	1.5	4.567	3.616	2.800	2.070	1.477
	2.0	4.054	3.146	2.397	1.730	1.165
	2.5	3.569	2.741	2.041	1.404	0.9079
	3.0	3.100	2.318	1.683	1.129	0.6878
	3.5	2.660	1.931	1.406	0.8801	0.5208
	4.0	2.261	1.605	1.112	0.6639	0.3757

SOLUBILITY OF SODIUM CHLORIDE IN AQUEOUS SOLUTIONS
OF HYDROGEN PEROXIDE AT 25°

(Akerlof and Turk, 1935.)

Wt. Percent H ₂ O ₂ in solvent	Gm. Mols. NaCl per 1000 gms. solvent	Wt. Percent H ₂ O ₂ in solvent	Gm. Mols. NaCl per 1000 gms. solvent
0.0	6.162	21.17	5.292
5.30	6.028	26.24	5.058
10.73	5.792	31.43	4.823
15.72	5.539		

SOLUBILITY OF SODIUM CHLORIDE IN PURE HYDROGEN PEROXIDE, DETERMINED
BY THE FREEZING-POINT METHOD. (Maass and Hatcher, 1922.)

t° of f. pt.	Gms. NaCl per 100 gms. sat. sol.	t° of f. pt.	Gms. NaCl per 100 gms. sat. sol.	t° of f. pt.	Gms. NaCl per 100 gms. sat. sol.
-2.37.....	1.08	-7.67....	8.61	-10.37....	15.63
-3.62.....	3.14	-10.7.....	11.81	0.0+...	17.0
-5.07.....	5.42				

SOLUBILITY OF MIXTURES OF SODIUM CHLORIDE AND OTHER
SALTS IN WATER, ETC.

Solvent.	t°.	Gms. per 100 Gms. Solvent.		Authority.
Water	17	26.4	NaCl + 22.1 NH ₄ Cl*	(Karsten.)
"	17	34.5	" + 4.1 BaCl ₂	"
"	?	38.3	" + 29.5 KNO ₃	"
"	25	38.5	" + 41.14 "	(Soch — J. Physic. Ch. 2, 46, '98.)
"	80	39.81	" + 168.8 "	"
Alcohol (40%)	25	15.78	" + 13.74 "	"
Water	20	30.54	" + 13.95 KCl	(Quoted by Euler — Z. physik. Ch. 49, 315, '04.)
"	25	28.90	" + 16.12 "	

* Sp. Gr. of solution at 17° = 1.179.

SOLUBILITY OF MIXTURES OF SODIUM CHLORIDE AND POTASSIUM SULFATE
IN WATER AT VARIOUS TEMPERATURES.
(Precht and Wittgen, 1882.)

t°.	Grams per 100 Grams H ₂ O.			t°.	Grams per 100 Grams H ₂ O.		
	NaCl	K ₂ SO ₄	KCl		NaCl	K ₂ SO ₄	KCl
10	33.4	8.1	3.2	60	36.4	11.9	2.7
20	34.0	8.9	3.1	70	36.6	12.8	3.2
30	34.6	9.6	2.9	80	36.0	12.3	5.1
40	35.2	10.4	2.8	90	35.9	12.4	7.0
50	35.8	11.1	2.8	100	35.6	12.6	8.8

EQUILIBRIUM IN SYSTEMS COMPOSED OF SODIUM AND
POTASSIUM CHLORIDES, NITRATES AND SULFATES.

Cl

Complete experimental data, including densities, in the form of tabular results and diagrams for these complex systems at temperatures between 0° and 90° are given by Cornec and Krombach, 1929 and Cornec, Krombach and Spack, 1930. These authors made use, wherever necessary of the results for the ternary systems previously reported from their own laboratory or by others including Chretien, 1929; Cornec and Hering, 1925-7, Cornec and Krombach, 1929; Meyerhoffer and Saunders, 1899; d'Ans, 1915 and Blasdale, 1918.

SOLUBILITY OF SODIUM CHLORIDE IN AQUEOUS SOLUTIONS OF:
(Herz and Hiebethal, 1929.)

Potassium Chromate		Potassium DiChromate		Potassium Permanganate	
Gm. Mol. per liter sat. sol.	NaCl	Gm. Mol. per liter sat. sol.	NaCl	Gm. Mol. per liter sat. sol.	NaCl
K ₂ CrO ₄ /6		K ₂ Cr ₂ O ₇ /6		KMnO ₄ /5	
0.71	5.25	0.16	5.29	0.0	5.38
0.93	5.18	0.40	5.28	0.02	5.29
1.31	5.12	0.79	5.25	0.49	5.24
1.86	5.04	1.29	5.16	1.26	5.09
3.57	4.65	1.57	5.11	+1.53	5.15
+4.49	4.25	+2.06	5.03		

SOLUBILITY OF SODIUM CHLORIDE IN AQUEOUS POTASSIUM NITRATE AT 25°
(Ritzel, 1911.)

Gms. per 100 cc. Sat. Sol.		Gms. per 100 cc. Sat. Sol.	
KNO ₃ .	NaCl.	KNO ₃ .	NaCl.
0	31.80	12	30.86
4	32.26	16	30.45
8	31.85	20	30.10

Data for the solubility of NaCl in aqueous MgCl₂ solutions are given by Feit and Przibylla (1909.)

SOLUBILITY OF SODIUM CHLORIDE IN AQUEOUS SOLUTIONS
OF MAGNESIUM CHLORIDE.

(Achromow and Wassilijew, 1932.)

t°	Gms. per 100 gms. H ₂ O		Solid Phase	t°	Gms. per 1000 gms. H ₂ O		Solid Phase
	MgCl ₂	NaCl			MgCl ₂	NaCl	
100	100	282	NaCl	175	100	330	NaCl
"	300	106	"	"	300	156	"
"	500	12	"	"	500	52	"
"(1.384)	718	8	" + MgCl ₂	"	900	13	"
125	100	298	NaCl	"(1.442)	1220	trace	" + MgCl ₂
"	300	120	"	200	100	354	NaCl
"	500	20	"	"	300	176	"
"(1.411)	902	5	" + MgCl ₂	"	500	60	"
150	100	312	NaCl	"	700	28	"
"	300	138	"	"	900	20	"
"	500	34	"	"(1.462)	1315	trace	" + MgCl ₂
"(1.428)	1072	2	" + MgCl ₂				

The figures in parentheses are densities.

Data for the equilibrium in the system Sodium Chloride, Magnesium Sulfate and Water at -5°, -8°, -15° and -20° are given by Iljinski and Sagaidotschny, 1931.

SOLUBILITY OF SODIUM CHLORIDE IN AQUEOUS AMMONIA AT 30°
(Hempel and Tedesco, 1911.)

d ₃₀ of Sat. Sol.	Gms. per 1000 cc. Sat. Sol.		d ₃₀ of Sat. Sol.	Gms. per 1000 cc. Sat. Sol.	
	NH ₃ .	NaCl.		NH ₃ .	NaCl.
1.1735	29.535	293.38	1.1406	72.07	283.38
1.1656	40.655	292.5	1.1395	72.715	283.06
1.160	47.26	289.7	1.1301	81.855	277.49
1.1494	60.78	286.5	1.1205	97.49	270.57

Data for equilibrium in the system sodium chloride, arsenic trioxide, water, at 30°, are given by Schreinemakers and deBaat (1915).

SOLUBILITY OF SODIUM CHLORIDE IN AQUEOUS SOLUTIONS OF AMMONIUM
CHLORIDE.
(Fedotieff, 1904.)

t°.	Wt. of 1 cc. Solution.	Mols. per 1000 Gms. H ₂ O.		Gms. per 1000 Gms. H ₂ O.	
		NH ₄ Cl.	NaCl.	NH ₄ Cl.	NaCl.
0	...	0	6.09	0	356.3
"	1.185	2.73	4.89	146.1	286.4
15	1.200	0	6.12	0	357.6
"	1.191	1.07	5.58	57.3	326.4
"	1.183	2.22	5.13	118.9	300
"	1.176	3.48	4.64	186.4	271.6
"	1.175	3.72	4.55	198.8	266.8
30	...	0	6.16	0	360.3
"	1.166	4.77	4.26	255.4	249
45	...	0	6.24	0	365
"	...	6.02	4	322.1	233.9

Results for the system $\text{NaCl} + \text{NH}_4\text{Cl} + \text{H}_2\text{O}$ at 0°, 20°, 50° and 75° are given by Gerassimow, 1930.

Data for the solubility of Sodium Chloride and of Sodium Chloride Penta-Ammoniate, in mixtures of Ammonia and Water at temperatures between -40° and +25° are given by Guyer, Bieler and Schmid, 1934. The present paper, however, contains only the diagrams drawn from the experimental results published in the Dissertation of Z. Schmid E.T.H. Zurich, 1934.

SOLUBILITY OF SODIUM CHLORIDE IN AQUEOUS SOLUTIONS OF SODIUM
BICARBONATE SATURATED WITH CO₂. (Fedotieff 1904.)

Cl

t°.	Wt. of 1 cc. Solution.	Mols. per 1000 Gms. H ₂ O.		Gms. per 1000 Gms. H ₂ O.	
		NaHCO ₃ .	NaCl.	NaHCO ₃ .	NaCl.
0	...	0	6.09	0	356.3
"	1.208	0.09	6	7.7	350.1
15	1.203	0	6.12	0	357.6
"	1.203	0.12	6.06	10	354.6
30	1.196	0	6.16	0	360.3
"	1.199	0.17	6.12	13.9	358.1
45	1.189	0	6.24	0	365
"	1.198	0.23	6.18	19.5	361.5

EQUILIBRIUM IN THE SYSTEM SODIUM CHLORIDE, SODIUM
CHLORATE AND WATER AT 20°.

(DiCapua and Scaletti, 1927.)

The authors results were plotted and the following values read from the curve.

Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase
NaCl	NaClO ₃		NaCl	NaClO ₃	
26.8	0.0	NaCl	10.	33.7	NaClO ₃
20.0	13.0	"	7.5	37.5	"
15.0	24.0	"	5.0	41.5	"
13.0	29.5	" + NaClO ₃	2.5	45.6	"
			0.0	49.6	"

SODIUM CHLORIDE

EQUILIBRIUM IN THE SYSTEM SODIUM CHLORIDE, SODIUM PERCHLORATE
AND WATER AT SEVERAL TEMPERATURES.

(Cornec and Dickely, 1928.)

t°	Gms. per 100 gms. sat. sol.		Solid Phase	t°	Gms. per 100 gms. sat. sol.		Solid Phase
	NaClO ₄	NaCl			NaClO ₄	NaCl	
0	23.86	15.44	NaCl.	50(1.749)	73.26	0	NaClO ₄ ·H ₂ O
"	40.65	8.63	"	" (1.749)	72.46	0.81	" + NaCl
"	52.82	4.37	"	55(1.756)	73.94	0.0	NaClO ₄
"	59.69	2.53	" + NaClO ₄ ·H ₂ O	" (1.755)	73.00	0.78	" + NaCl
"	62.87	0.0	NaClO ₄ ·H ₂ O	75(1.757)	75.01	0.0	NaClO ₄
15(1.663)	65.63	0.0	"	" (1.757)	74.15	0.83	" + NaCl
25(1.683)	67.82	0.0	"	100(1.758)	76.75	0.0	NaClO ₄
"(1.683)	66.58	1.37	" + NaCl	" (1.757)	75.79	0.88	" + NaCl
38(1.713)	70.38	0.0	"	" (1.664)	69.32	1.44	NaCl
"(1.713)	69.41	1.05	" + NaCl	" (1.532)	50.23	3.06	"
				" (1.567)	41.44	8.81	"

The figures in parentheses are densities.

Cl

SOLUBILITY OF SODIUM CHLORIDE IN AQUEOUS SOLUTIONS OF SODIUM DICHROMATE.
(Robertson, 1924.)

The mixtures of salts were dissolved in water at a temperature higher than that of the experiment and the flasks then placed in a thermostat. Constant agitation is not mentioned.

Results at 25°.		Results at 50°.		Results at 100°.		Solid Phase. at Each Temperature.
Gms. per 100 gms. sat. sol.		Gms. per 100 gms. sat. sol.		Gms. per 100 gms. sat. sol.		
Na Cl.	Na ₂ Cr ₂ O ₇ .	Na Cl.	Na ₂ Cr ₂ O ₇ .	Na Cl.	Na ₂ Cr ₂ O ₇ .	
24.0	5.18	24.2	5.87	25.1	6.28	NaCl
21.0	11.7	20.8	13.0	18.3	20.0	"
18.0	17.8	19.1	16.4	15.4	26.5	"
15.4	23.8	15.8	23.1	11.7	34.9	"
13.3	28.8	13.1	29.4	9.06	41.1	"
10.7	35.0	11.1	34.3	5.59	50.9	"
8.8	39.3	8.43	41.3	4.14	55.4	"
6.61	45.1	4.57	52.3	2.66	62.3	"
4.67	50.6	2.71	58.1	1.64	68.6	"
3.10	57.1	1.94	63.4	1.22	71.9	"
1.13	64.6	0.94	70.2	0.74	80.0	" + Na ₂ Cr ₂ O ₇ ·2H ₂ O
0.0	65.5	0.0	70.3	0.0	80.1	Na ₂ Cr ₂ O ₇ ·2HO*

* Na₂Cr₂O₇ at 100°.Data for the 4 component system (K, Na) — (Cl, Cr₂O₇) — H₂O are also given.

EQUILIBRIUM IN THE SYSTEM SODIUM CHLORIDE, SODIUM DICHROMATE AND WATER.
(Gerassimow, 1930.)

Results at 0° Results at 20° Results at 50° Results at 75°

Qms. per 100 gms. sat. sol.		Qms. per 100 gms. sat. sol.		Qms. per 100 gms. sat. sol.		Qms. per 100 gms. sat. sol.		Solid Phase at each Temperature
NaCl	Na ₂ Cr ₂ O ₇	NaCl	Na ₂ Cr ₂ O ₇	NaCl	Na ₂ Cr ₂ O ₇	NaCl	Na ₂ Cr ₂ O ₇	
26.00	0.0	26.43	0.0	26.91	0.0	27.45	0.0	NaCl
24.35	4.10	10.45	38.43	23.56	7.09	23.24	9.00	"
5.81	50.81	3.44	57.42	17.02	21.48	15.66	26.64	"
—	—	2.46	59.82	11.73	32.46	9.30	41.96	"
—	—	—	—	11.47	33.12	2.95	63.76	"
—	—	—	—	1.06	68.22	1.52	71.52	"
2.49	58.69	1.74	62.50	1.21	68.79	1.25	76.18	" + Na ₂ Cr ₂ O ₇ ·2H ₂ O
0.0	62.0	0.0	65.20	0.0	71.3	0.0	77.7	Na ₂ Cr ₂ O ₇ ·2H ₂ O

Results are also given for the quaternary systems obtained with
Na₂Cr₂O₇ + NH₄Cl + H₂O.

EQUILIBRIUM IN THE SYSTEM SODIUM CHLORIDE, SODIUM
FLUORIDE AND WATER.
(Foote and Schairer, 1930.)

Cl

t°	Qms. per 100 gms. sat. sol.		Solid Phase	t°	Qms. per 100 gms. sat. sol.		Solid Phase
	NaCl	NaF			NaCl	NaF	
25	26.40	0.0	NaCl	35	26.18	0.34	NaCl + NaF
"	26.12	0.31	" + NaF	"	26.13	0.29	"
"	26.24	0.12	" "	"	18.43	0.54	NaF
"	0.0	3.98	NaF	"	5.41	2.38	"
35	26.62	0.0	NaCl	"	0.0	4.00	"

The authors also give the following results for the eutectic and transition temperatures of the above system.

t°	Qms. per 100 gms. sat. sol.		Solid Phase
	NaCl	NaF	
-21.19	23.69	0.24	Ice + NaCl·2H ₂ O + NaF
-20.94	23.18	0.0	" + NaCl·2H ₂ O
-3.02	0.0	4.02	" + NaF
-2.98	0.0	3.82	" + "
-0.06	26.25	0.19	NaCl·2H ₂ O + NaCl + NaF
+0.08	26.39	0.0	" + "
+0.10	26.53	0.0	" + "

EQUILIBRIUM IN THE SYSTEM SODIUM CHLORIDE, SODIUM FLUORIDE,
SODIUM SULFATE AND WATER.

(Foote and Schairer, 1930.)

Results at 25°

Gms. per 100 gms. sat. sol.			Solid Phase
Na_2SO_4	NaF	NaCl	
7.71	0.69	6.98	1.1
4.60	0.77	14.35	"
4.47	trace	18.41	"
4.35	0.60	21.48	"
9.72	trace	19.29	" + NaS
5.23	"	23.61	" + NaCl
14.76	"	13.78	" + NaS + NaS.10
6.98	"	22.73	" + " + NaCl
0.50	0.23	25.93	" + NaF + "
0.21	0.43	25.96	" + " + "

Results at 35°

Gms. per 100 gms. sat. sol.			Solid Phase
Na_2SO_4	NaF	NaCl	
1.51	trace	23.34	1.1
4.39	0.61	21.64	"
5.08	0.24	15.49	"
17.66	0.13	8.55	"
3.66	0.46	24.32	" + NaCl
6.89	trace	22.31	" + NaS
21.39	"	8.09	" + "
0.24	0.43	22.36	" + NaF
4.84	1.80	5.42	" + "
0.49	0.12	26.08	" + " + NaCl
0.17	0.31	26.18	" + " + "
6.14	trace	23.37	" + NaS + NaCl

1.1 = $\text{Na}_2\text{SO}_4 \cdot \text{NaF}$; NaS = Na_2SO_4 ; NaS.10 = $\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}$.EQUILIBRIUM IN THE SYSTEM SODIUM CHLORIDE, SODIUM
IODATE AND WATER.

(Foote and Vance, 1929.)

Cl

Gms. per 100 gms. sat. sol.		Solid Phase
NaIO_3	NaCl	
Results at 0°		
0.0	26.34	NaCl
0.35	26.31	" + D.S.
0.54	24.16	D.S.
0.73	22.66	"
1.03	20.86	" + NaI.5
0.83	16.30	NaI.5
2.42	0.0	"

Results at 15°

0.0	26.38	NaCl
0.97	26.19	" + D.S.
1.29	24.64	D.S.
1.70	23.14	" + NaI.1
1.75	20.73	NaI.1
1.87	16.32	"
2.34	9.46	" + NaI.5

Gms. per 100 gms. sat. sol.			Solid Phase
NaIO_3	NaCl		

Results at 15° (con.)

2.35	6.60	NaI.5
5.88	0.0	"

Results at 25°

0.0	26.50	NaCl
1.97	26.03	" + NaI.1
8.66	0.0	NaI.1

Results at 35°

0.0	26.66	NaCl
1.70	26.20	"
2.39	26.03	" + NaI.1
2.47	23.15	NaI.1
2.57	21.24	"
4.51	7.87	"
10.57	0.0	"

The following eutectics and transition points were also determined.

°	Gms. per 100 gms. sat. sol.		Solid Phase
	NaIO_3	NaCl	
-21.8 Eutec.	0.36	23.28	Ice + D.S. + $\text{NaCl} \cdot 2\text{H}_2\text{O}$
-16.9 "	0.34	19.93	" + " + NaI.5
+ 0.04 tr.pt.	0.39	26.33	D.S. + NaCl + $\text{NaCl} \cdot 2\text{H}_2\text{O}$
6.8 "	1.66	20.76	" + NaI.1 + NaI.5
24.6 "	1.95	25.98	" + " + NaCl

D.S. = $3\text{NaCl} \cdot 2\text{NaIO}_3 \cdot 10\text{H}_2\text{O}$; NaI.5 = $\text{NaIO}_3 \cdot 5\text{H}_2\text{O}$; NaI.1 = $\text{NaIO}_3 \cdot \text{H}_2\text{O}$.

EQUILIBRIUM IN THE SYSTEM SODIUM CHLORIDE, SODIUM IODIDE AND WATER.
(Ricci and Yanick, 1936.)

t°	d. of sat.	Gms. per 100 gms.		Solid Phase	t°	d. of sat.	Gms. per 100 gms.		Solid Phase
		NaCl	NaI				NaCl	NaI	
10	—	19.91	12.67	NaCl	25	1.836	0.72	61.43	NaCl
"	—	10.43	32.36	"	"	1.887	0.45	63.97	"
"	—	3.86	48.45	"	"	1.904	0.40	64.33	" + NaI.2H ₂ O
"	—	0.67	62.00	" + NaI.2H ₂ O	50	—	15.37	22.75	NaCl
25	1.304	18.02	16.61	"	"	—	0.26	69.00	" + NaI.2H ₂ O
"	1.367	14.04	24.72	"	75	—	15.88	22.37	NaCl
"	1.464	9.14	35.24	"	"	—	0.18	74.45	" + NaI
"	1.593	4.59	46.48	"	100	—	16.70	22.18	NaCl
"	1.714	2.06	54.84	"	"	—	0.39	74.70	" + NaI

SOLUBILITY OF SODIUM CHLORIDE IN AQUEOUS SOLUTIONS OF SODIUM NITRATE
AND VICE VERSA.
(Leather and Mukerji, 1913.)

Cl

Results at 30°.			Results at 40°.			Results at 91°.			Solid Phase in Each Case.
d_{30}^o Sat. Sol.	Gms. per 100 Gms. H ₂ O.		d_{40}^o Sat. Sol.	Gms. per 100 Gms. H ₂ O.		d_{91}^o Sat. Sol.	Gms. per 100 Gms. H ₂ O.		
	NaNO ₃ .	NaCl.		NaNO ₃ .	NaCl.		NaNO ₃ .	NaCl.	
I. 202	0	36.3	I. 197	0	36.53	I. 189	0	38.72	NaCl
I. 276	24.21	31.16	I. 284	27.31	30.53	I. 296	37.43	30.21	"
I. 343	48.15	26.35	I. 323	54.82	26.50	I. 381	79.65	23.17	"
I. 379	63.08	23.50	I. 409	73.96	21.87	I. 487	127.2	17.05	"
I. 388	63.40	23.40	I. 397	74.01	21.71	I. 519	141.4	15.93	" + NaNO ₃
I. 381	67.91	19.69	I. 396	75.29	21.61	I. 518	141.3	15.83	" NaNO ₃
I. 394	81.46	9.76	I. 410	89.90	10.80	I. 504	149.5	9.03	"
I. 406	95.90	0	I. 421	105.2	0	I. 521	160.8	0	"

Results are also given at 20° which agree satisfactorily with those of Nicol. Additional results at 30°, agreeing fairly well with the above, are given by Coppadoro (1913). Data for the solubility of sodium chloride in dilute solutions of sodium nitrate at 0° and at 25° are given by Armstrong and Eyre (1910-11).

Data for equilibrium in the System Na₂O + N₂O₃ + HCl + H₂O, at 15°, 25° and 35° are given by Nikolajew, 1927.

EQUILIBRIUM IN THE QUARTERNARY SYSTEM SODIUM CHLORIDE,
SODIUM NITRATE, SODIUM SULFATE AND WATER.

(Chretien 1926, 1927, 1929; See also Guillier, 1927 and
Pfeiffenberger and Leimbach, 1928.)

The author gives in this very exhaustive paper the complete numerical and diagrammatical results (with densities) for binary, ternary and quaternary equilibrium in this system at very frequent temperature intervals between -24.4° and $+121.7^{\circ}$. The following are the values given for the quaternary equilibrium at 25° .

d. of sat. sol.	Gms. per 100 gms. sat. sol.			Solid Phase
	NaNO_3	NaCl	Na_2SO_4	
1.281	7.08	9.98	14.9	$\text{Na}_2\text{SO}_4 + \text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}$
—	12.40	6.42	15.0	" + "
1.325	18.50	3.15	15.0	" + "
1.291	11.7	18.6	5.34	" + NaCl
1.322	18.2	16.6	4.50	" + " + D
1.319	20.0	13.0	5.92	" + D
1.325	22.0	8.68	8.19	" + "
1.333	23.9	4.32	10.8	" + "
—	22.6	15.3	3.30	NaCl + "
1.357	26.5	14.0	2.45	" + "
1.378	31.2	12.7	1.88	" + " + NaNO_3
1.387	37.7	6.41	2.51	NaNO_3 + D
1.396	41.0	3.43	2.8	" + "

D = Darapskite, $\text{NaNO}_3 \cdot \text{Na}_2\text{SO}_4 \cdot 11\text{H}_2\text{O}$.

Solubility studies made over a period of some ten years by many investigators including Cornec and his students have established the diagrams representing the equilibrium in aqueous solutions of the chloride, nitrate and sulfate of sodium at various temperatures. Using these results Graziadei, 1935, 1936, has worked out a graphic method of calculating the yield of nitrate obtained by cooling solutions of two and of three salts. A simple formula of practical application has been deduced.

SOLUBILITY OF SODIUM CHLORIDE IN AQUEOUS SODIUM HYDROXIDE
SOLUTIONS.

(Engel; Winteler, 1900.)

At 0° (Engel).

At 20° (Winteler).

Mg. Mols. per 10 cc.		Sp. Gr. of Solutions.	Gms. per Liter.		Gms. per Liter.		Sp. Gr. of Solutions.
Na_2O .	NaCl .		NaOH .	NaCl .	NaOH .	NaCl .	
0	54.7	1.207	0	320	10	308	1.200
4.8	49.38	1.221	38.4	288.9	50	297	1.230
6.73	47.21	1.225	53.8	276.2	100	253	1.250
10.41	42.38	1.236	83.2	247.9	150	213	1.270
14.78	39.55	1.249	118.2	231.4	200	173	1.290
30.50	24.95	1.295	244	146	300	112	1.330
37.88	19.30	1.314	303	112.9	400	61	1.375
53.25	9.41	1.362	426	55	500	30	1.425
					640	18	1.490

SOLUBILITY OF SODIUM CHLORIDE IN AQUEOUS SODIUM HYDROXIDE AT 30°.
(Schreinemakers, 1909-10, 1910.)

Gms. per 100 Gms. Sat. Sol.		Solid Phase.	Gms. per 100 Gms. Sat. Sol.		Solid Phase.
Na ₂ O.	NaCl.		Na ₂ O.	NaCl.	
0	26.47	NaCl	29.31	2.40	NaCl
4.47	21.49	"	37.85	1.12	"
12.22	13.62	"	41.42	0.97	" + NaOH.H ₂ O
24.48	4.36	"	±42	0	NaOH.H ₂ O

SOLUBILITY OF SODIUM CHLORIDE IN AQUEOUS SODIUM HYDROXIDE AT 25°.
(Akerlof and Short, 1937.)

Gm. Mols. per 1000 gms. H ₂ O		Gm. Mols. per 1000 gms. H ₂ O		Gm. Mols. per 1000 gms. H ₂ O		Gm. Mols. per 1000 gms. H ₂ O	
NaOH	NaCl	NaOH	NaCl	NaOH	NaCl	NaOH	NaCl
0.920	5.613	6.688	2.635	12.35	1.074	19.30	0.451
1.858	5.048	7.141	2.442	13.27	0.940	20.30	0.421
2.714	4.672	8.031	2.173	14.38	0.781	21.05	0.396
3.070	4.486	8.876	1.956	15.20	0.714	21.94	0.371
3.812	4.048	9.824	1.558	16.25	0.580	22.82	0.356
4.798	3.610	11.437	1.280	17.32	0.533	23.68	0.356
5.721	3.206	11.582	1.253	17.83	0.492	23.56	0.346

Cl

The solid phase is NaCl in all cases.

EUTECTIC POINTS OF THE SYSTEM SODIUM CHLORIDE, SODIUM HYDROXIDE AND WATER. (von Antropoff, 1924.)

Eutec. t°.	Gms. per 100 gms. sat. sol.		Solid Phase.	Eutec. t°.	Gms. per 100 gms. sat. sol.		Solid Phase.
	NaCl.	NaOH.			NaCl.	NaOH.	
-30.15.	16.55	8.87	Ice+NaCl.2H ₂ O	20..	0.78	51.07	NaCl+NaOH.H ₂ O
-21.30.	23.6	-	" + "	30..	0.85	53.09	" "
-32.8..	8.58	18.38	" + NaOH.γH ₂ O	40..	0.98	55.11	" "
-29.8..	4.20	20.72	" + NaOH.γH ₂ O	50..	1.28	57.58	" "
-28.25.	-	19.00	" "	60..	1.70	62.64	" "
-28.00.	-	22.55	" "	70..	2.40	70.40	" + NaOH
-21.3..	6.02	26.04	NaCl+NaOH.βH ₂ O(2)	80..	2.95	72.16	" "
-11.1..	5.89	27.08	" "	90..	3.45	72.73	" "
0.0..	4.85	29.06	" + NaOH.3.5H ₂ O	120..	4.86	73.39	" "
10.0..	3.24	33.24	" " "	150..	7.02	74.10	" "
0.0..	1.83	36.98	" 3.11 " *	180..	8.75	76.05	" "
10.0..	0.87	47.19	" + NaOH.2H ₂ O				

* Unstable.

Additional data for this system are given by von Antropoff and Sommer, 1926

SOLUBILITY OF SODIUM CHLORIDE IN AQUEOUS SOLUTIONS OF SODIUM HYDROXIDE
AT VARIOUS TEMPERATURES. (von Antropoff, 1924.)

Constant agitation was employed and equilibrium was approached from above and from below. Silver lined apparatus was used and the determinations were made with the greatest care. The results for 16 isotherms were plotted and the dissolved sodium chloride, and specific gravities of the solutions corresponding to regular intervals of concentration of sodium hydroxide, were read from the curves. The figures in parentheses are the specific gravities of the saturated solutions.

Gms. NaOH per 100 gms. sat. sol.	Gms. Na Cl dissolved per 100 gms. sat. solution at						
	- 21.3°.	- 11°.1.	0°.	+ 10°	20°	30°.	40°.
5...	20.1(1.2333)	21.0(1.229)	21.9(1.232)	22.0(1.227)	22.1(1.233)	22.2(1.218)	22.3(1.218)
10...	16.9(1.260)	17.5(1.259)	17.8(1.254)	17.9(1.250)	18.0(1.243)	18.1(1.243)	18.2(1.241)
15...	13.7(1.287)	13.9(1.286)	14.1(1.279)	14.2(1.276)	14.3(1.270)	14.4(1.271)	14.5(1.269)
20...	10.3(1.318)	10.4(1.313)	10.5(1.308)	10.6(1.306)	10.7(1.298)	10.8(1.297)	10.9(1.296)
25...	7.0(1.350)	7.1(1.342)	7.2(1.337)	7.3(1.334)	7.4(1.330)	7.5(1.329)	7.7(1.326)
30...	—	—	4.3(1.373)	4.5(1.370)	4.7(1.368)	4.9(1.363)	5.0(1.359)
35...	—	—	2.2(1.415)	2.5(1.412)	2.8(1.406)	3.0(1.400)	3.1(1.398)
40...	—	—	—	1.3(1.453)	1.6(1.446)	1.8(1.441)	2.0(1.438)
45...	—	—	—	0.9(1.501)	1.1(1.490)	1.3(1.484)	1.5(1.480)
50...	—	—	—	—	0.8(1.540)	1.0(1.530)	1.2(1.525)
55...	—	—	—	—	—	—	1.0(1.574)

Gms. NaOH per 100 gms. sat. sol.	Grams Na Cl dissolved per 100 gms. sat. solution at							
	50°.	60°	70°.	80°.	90°.	120°.	150°.	180°.
5...	22.4(1.213)	22.8(1.211)	23.0(1.209)	23.4(1.205)	23.7(1.200)	24.6	25.6	27.0
10...	18.3(1.237)	18.7(1.236)	19.0(1.231)	19.3(1.229)	19.6(1.224)	20.4	21.8	23.0
15...	14.7(1.264)	14.9(1.262)	15.0(1.258)	15.5(1.256)	15.8(1.254)	16.8	18.0	19.6
20...	11.1(1.292)	11.4(1.290)	11.7(1.288)	12.1(1.287)	12.4(1.284)	13.3	15.0	16.3
25...	8.0(1.323)	8.4(1.322)	8.6(1.320)	9.1(1.320)	9.5(1.318)	10.5	12.1	13.8
30...	5.3(1.357)	5.8(1.360)	6.0(1.355)	6.6(1.356)	7.1(1.352)	8.2	10.0	11.8
35...	3.4(1.394)	3.9(1.400)	4.1(1.393)	4.7(1.397)	5.2(1.390)	6.5	8.3	10.0
40...	2.3(1.434)	2.7(1.437)	3.0(1.432)	3.5(1.435)	3.9(1.428)	5.2	7.0	8.9
45...	1.8(1.474)	2.0(1.472)	2.3(1.474)	2.7(1.472)	3.0(1.465)	4.4	6.1	8.0
50...	1.5(1.517)	1.7(1.515)	2.0(1.512)	2.4(1.510)	2.7(1.508)	3.8	5.6	7.7
55...	1.3(1.566)	1.7(1.563)	2.0(1.561)	2.3(1.560)	2.6(1.558)	3.6	5.4	7.4
60...	—	1.7(1.610)	2.1(1.610)	2.4(1.609)	2.7(1.608)	3.8	5.7	7.7
65...	—	2.2	—	2.6	2.9(1.650)	4.1	6.0	7.9
70...	—	2.4	—	2.8	3.2(1.70)	4.5	6.5	8.1
75...	—	—	—	—	—	—	—	8.5

Cl

Results in close agreement with the above at 0°, 15°, 20°, 25°, 30°, 35°, 45° and 60° are given by Freeth, 1922.

SOLUBILITY OF SODIUM CHLORIDE IN AQUEOUS SOLUTIONS OF SODIUM HYDROXIDE
AT THE BOILING-POINT. (von Antropoff, 1924.)

t° of B. pt.	d of sat. sol.	Gms. per 100 gms. sat. sol.		t° of B. pt.	d of sat. sol.	Gms. per 100 gms. sat. sol.	
		Na Cl.	Na OH.			Na Cl.	Na OH.
108.8...	1.172	28.9	0.0	123.0...	1.346	8.7	30.0
110.0...	1.195	24.8	5.0	128.7...	1.381	7.4	35.0
111.5...	1.222	20.9	10.0	135.0...	1.416	6.5	40.0
112.2...	1.252	15.0	15.0	145.0...	1.450	5.0	45.0

Na NATRIUM

1234

EQUILIBRIUM IN THE SYSTEM SODIUM CHLORIDE SODIUM
SULFATE AND WATER.

(Chretien, 1926, 1929.)

t°	Gms. per 100 gms. sat. sol.		Solid Phase	t°	Gms. per 100 gms. sat. sol.		Solid Phase
	NaCl	Na ₂ SO ₄			NaCl	Na ₂ SO ₄	

Results at 0°

-21.7	22.8	0.12	Ice + Cl.2 + S.10
-21.32	23.43	0.31(1)	
-21.6	22.9	0.0	" + Cl.2
-20.94	23.18	0.0 (1)	" + "
- 1.2	0.0	3.79	" + S.10
- 0.1	25.3	1.39	Cl.2 + S.10 + Cl
0.0	25.79	1.32(1)	" + " "

Results at 30°

(1.283)	3.35	26.0	S.10
(1.291)	5.68	25.0	" + S
—	12.2	16.2	S
—	18.0	9.70	"
1.237	23.0	6.68	" + Cl

Results at 50°

(1.247)	7.85	20.8	S
(1.216)	16.1	11.3	"
(1.223)	24.1	5.54	" + Cl
(1.203)	25.4	2.56	Cl

Results at 10.2°

d.			
(1.102)	8.78	4.07	S.10
(1.159)	17.2	3.26	"
(1.224)	24.3	3.39	" + Cl

Results at 75°

—	7.76	19.7	S
—	16.5	10.2	"
1.207	25.3	4.95	" + Cl
1.189	26.4	2.14	Cl

Results at 15°

(1.236)	23.2	5.41	S.10 + Cl
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Results at 17.5°

(1.339)	8.12	8.51	S.10
(1.190)	16.9	6.8	"
(1.247)	22.3	7.31	" + Cl

Result at 17.9°

—	22.3	7.57	S.10 + S + Cl
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Results at 25°

(1.207)	7.66	16.0	S.10
—	14.5	14.5	" + S
—	14.12	14.93(1)	" + S
—	13.61	15.18(3)	" + Cl
(1.239)	18.4	10.4	S
(1.243)	22.7	7.06	" + Cl
—	22.77	6.92(1)	" + "
—	22.98	6.80(3)	" + "
(1.216)	24.6	3.35	Cl

Results at 94.5 (2)

—	23.2	26.3	S
—	15.56	10.8	"
—	25.8	4.42	" + Cl
—	27.15	2.43	Cl

Results at 100°

—	7.67	18.6	S
—	18.4	8.75	"
1.194	25.9	4.51	" + Cl
1.777	27.2	1.84	Cl

Result at 109.1° (b.pt.)

—	26.4	5.01	S + Cl
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Cl.2 = NaCl.2H₂O; Cl = NaCl; S.10 = Na₂SO₄.10H₂O; S = Na₂SO₄.

(1) (Foote and Schairer, 1930.)

(2) (Pelling, 1925.)

(3) (Takejani, 1920, 1921.)

Additional results at 0° and at 25°, in terms of gm. mols. NaCl and of Na₂SO₄ per 1000 gm. mols. H₂O, are given by Kournakow and Zemcznyj, 1924.Chretien also gives very complete numerical and diagramatic results (with densities) for equilibrium in the quaternary system NaCl + Na₂SO₄ + NaNO₃ at frequent temperature intervals between -24.4° and + 121.7°.

EQUILIBRIUM IN THE SYSTEM SODIUM CHLORIDE, SODIUM
SULFATE AND WATER AT SEVERAL TEMPERATURES.

(Seidell, 1902.)

Results at 10°.

Sp. Gr. of Solutions.	Gms. per 100 Gms. H ₂ O.	
	NaCl.	Na ₂ SO ₄ .
I. 080	0.0	9.14
I. 083	4.28	6.42
I. 102	9.60	4.76
I. 150	15.65	3.99
I. 164	21.82	3.97
I. 192	28.13	4.15
I. 207	30.11	4.34
I. 217	32.27	4.59
I. 223	33.76	4.75

Results at 21.5°.

Sp. Gr. of Solutions.	Gms. per 100 Gms. H ₂ O.	
	NaCl.	Na ₂ SO ₄ .
I. 164	0.0	21.33
I. 169	9.05	15.48
I. 199	17.48	13.73
I. 214	20.41	13.62
I. 243	26.01	15.05
I. 244	26.53	14.44
I. 244	27.74	13.39
I. 244	31.25	10.64
I. 243	31.80	10.28
I. 245	32.10	8.43
I. 219	33.69	4.73
I. 212	34.08	2.77
I. 197	35.46	0.00

Results at 27°.

Sp. Gr. of Solutions.	Gms. per 100 Gms. H ₂ O.	
	NaCl.	Na ₂ SO ₄ .
I. 228	0.0	31.10
I. 230	2.66	28.73
I. 230	5.29	27.17
I. 235	7.90	26.02
I. 259	16.13	24.83
I. 253	18.91	21.39
I. 249	19.64	20.11
I. 245	20.77	19.29
I. 238	32.33	9.53

Results at 30°.

Sp. Gr. of Solutions.	Gms. per 100 Gms. H ₂ O.	
	NaCl.	Na ₂ SO ₄ .
I. 281	0.0	39.70
I. 282	2.45	38.25
I. 284	5.61	36.50
I. 290	7.91	35.96
I. 276	10.61	31.64
I. 270	12.36	29.87
I. 258	15.65	25.02
I. 249	18.44	21.30
I. 244	20.66	19.06
I. 236	32.43	9.06

Results at 33°.

Sp. Gr. of Solutions.	Gms. per 100 Gms. H ₂ O.	
	NaCl.	Na ₂ SO ₄ .
I. 329	0.0	48.48
I. 323	1.22	46.49
I. 318	1.99	45.16
I. 315	2.64	44.09
I. 309	3.47	42.61
I. 265	12.14	29.32
I. 237	21.87	16.83
I. 234	32.84	8.76
I. 217	33.99	4.63
I. 208	34.77	2.75

Results at 35°.

Sp. Gr. of Solutions.	Gms. per 100 Gms. H ₂ O.	
	NaCl.	Na ₂ SO ₄ .
I. 324	0.0	47.94
I. 314	2.14	43.75
I. 256	13.57	26.26
I. 238	18.78	19.74
I. 231	31.91	8.28
I. 193	35.63	0.00

Cl

EQUILIBRIUM IN THE SYSTEM SODIUM CHLORIDE, SODIUM
SULFATE AND WATER AT 15°.

((Schreinemakers and de Baat, 1909.))

Gms. per 100 Gms. Sat. Sol.		Solid Phase.	Gms. per 100 Gms. Sat. Sol.		Solid Phase.
NaCl.	Na ₂ SO ₄ .		NaCl.	Na ₂ SO ₄ .	
5.42	7.86	Na ₂ SO ₄ .10H ₂ O	21.03	5.26	Na ₂ SO ₄ .10H ₂ O
11.51	5.87	"	23.39	5.64	" + NaCl
15.97	5.23	"	25.21	2.26	NaCl

EQUILIBRIUM IN THE SYSTEM SODIUM CHLORIDE, SODIUM SULFATE AND WATER AT 25°.

(Cameron, Bell and Robinson, 1907.)

d_{25} of Sat. Sol.	Gms. per 100 Gms. H ₂ O.		Solid Phase.	d_{25} of Sat. Sol.	Gms. per 100 Gms. H ₂ O.		Solid Phase.
	NaCl.	Na ₂ SO ₄ .			NaCl.	Na ₂ SO ₄ .	
I. 2173	2.96	26.60	Na ₂ SO ₄ .10H ₂ O	I. 2429	26.54	12.64	Na ₂ SO ₄
I. 2162	5.79	24.32	"	I. 2438	31.06	9.98	"
I. 2150	9.90	21.41	"	I. 2451	32.41	9.93	"
I. 2275	13.43	19.62	"	I. 2453	33	9.84	" + NaCl
I. 2385	15.82	19.64	"	I. 2309	33.81	6.66	NaCl
I. 2571	19.13	20.73	" + Na ₂ SO ₄	I. 2162	34.60	3.38	"
I. 2476	23.22	16.28	Na ₂ SO ₄	I. 2002	35.80	0	"

Data are also given for the system sodium sulfate, sodium chloride, calcium sulfate and water at 25°.

EQUILIBRIUM IN THE SYSTEM SODIUM CHLORIDE, SODIUM THIOSULFATE AND WATER AT 25°.

(Radiscev, 1928.)

Cl

Gms. per 100 Na ₂ S ₂ O ₃	Gms. sat. sol. NaCl	Solid Phase	Gms. per 100 Na ₂ S ₂ O ₃	Gms. sat. sol. NaCl	Solid Phase
0	26.45	NaCl	32.98	9.86	NaCl + Na ₂ S ₂ O ₃ .5H ₂ O
4.54	24.11	"	33.80	9.03	Na ₂ S ₂ O ₃ .5H ₂ O
9.80	21.62	"	35.48	7.31	"
16.66	18.00	"	39.52	3.37	"
25.67	13.37	"	43.10	0.0	"

EQUILIBRIUM IN THE SYSTEM SODIUM CHLORIDE, LEAD CHLORIDE AND WATER AT 25°.

(Deacon, 1927.)

Gms. per 100 NaCl	Gms. H ₂ O PbCl ₂	Solid Phase	Gms. per 100 NaCl	Gms. H ₂ O PbCl ₂	Solid Phase
35.96	0.0	NaCl	10.00	0.214	PbCl ₂
36.30	0.82	"	8.00	0.188	"
36.70	2.01	"	6.00	0.175	"
36.99	3.48	" + PbCl ₂	5.00	0.167	"
32.0	2.15	PbCl ₂	4.00	0.172	"
28.0	1.38	"	2.00	0.209	"
24.0	0.89	"	1.56	0.252	"
20.0	0.60	"	0.50	0.720	"
14.30	0.352	"	0.0	1.087	"

SOLUBILITY OF SODIUM CHLORIDE IN AQUEOUS METHYL ALCOHOL.

(Armstrong and Eyre, 1910-11.)

Results at 0°.		Results at 25°.	
Solvent, Gms. CH ₃ OH per 1000 Gms. H ₂ O.	Gms. NaCl per 100 Gms. Sat. Sol.	Solvent, Gms. CH ₃ OH per 1000 Gms. H ₂ O.	Gms. NaCl per 100 Gms. Sat. Sol.
0	26.35	8.01	26.29
8.01	26.05	16.02	26.02
16.02	25.79	32.04	25.50
32.04	29.19	96.12	23.50

A sat. solution of NaCl in CH₃OH contains 0.1 gm. NaCl per 100 gms. solution at the critical temperature. (Centnerszwer, 1910.)

SOLUBILITY OF SODIUM CHLORIDE IN AQUEOUS SOLUTIONS OF METHYL ALCOHOL AT 25°.

(Akerlof and Turck, 1935.)

Wt. % CH ₃ OH in solvent	Gm. Mols. NaCl per 1000 gms. solvent	Wt. % CH ₃ OH in solvent	Gm. Mols. NaCl per 1000 gms. solvent
0.0	6.162	60.10	1.328
10.59	5.038	70.83	0.8656
20.49	4.096	80.45	0.5544
30.16	3.273	89.29	0.3685
39.80	2.552	100.00	0.2367
50.65	1.896		

Cl

SOLUBILITY OF SODIUM CHLORIDE IN AQUEOUS ETHYL ALCOHOL.

t°	Wt. % C ₂ H ₅ OH in solvent	Gms. NaCl per 100 gms. solvent	Authority
20	50.0	9.8	Wright, 1927.
25	20.4	22.86	Flatt and Jordan, 1933.
"	42.5	12.84	" " " "
"	67.9	4.07	" " " "
100	50.0	12.1	Wright, 1927.

SOLUBILITY OF SODIUM CHLORIDE IN ALCOHOLS.

(At 18.5°, de Bruyn — Z. physik. Ch. 10, 782, '92; Rohland — Z. anorg. Ch. 18, 327, 98.)

t°.	Alcohol.	Gms. NaCl per 100 Gms. Alcohol	t°.	Alcohol	Gms. NaCl per 100 Gms. Alcohol
18.5	Abs. Methyl	1.41	room temp.	Methyl $d_{15} = 0.799$	1.33
"	" Ethyl	0.065	"	Ethyl $d_{15} = 0.81$	0.176
			"	Propyl $d_{15} = 0.816$	0.033

SOLUBILITY OF SODIUM CHLORIDE IN AQUEOUS ETHYL ALCOHOL SOLUTIONS.

(Bodländer — Z. physik. Ch. 7, 317, '91; Taylor — J. Phys. Ch. 1, 723, '97; also Bathrick — *Ibid.* 1, 159, '96.)

Results at 11.5° (B.).

Sp. Gr. of Solutions.	Gms. per 100 cc. Solution.		
	C ₂ H ₅ OH.	H ₂ O.	NaCl
1.2035	0	86.62	31.73
1.1865	2.86	86.14	29.66
1.1710	5.41	83.93	27.77
1.1548	7.93	81.50	26.05
1.1350	10.84	78.78	24.28
1.1390	11.22	78.62	23.65
1.1088	16.85	73.40	20.63

Results at 13° (B.).

Sp. Gr. of Solutions.	Gms. per 100 cc. Solution.		
	C ₂ H ₅ OH.	H ₂ O.	NaCl.
1.2030	0	88.70	31.60
1.1348	11.81	78.41	23.26
1.1144	15.99	74.64	20.81
1.0970	19.39	71.45	18.86
1.0698	24.95	65.80	16.23
1.0295	32.33	57.96	12.66
0.9880	40.33	49.34	9.13
0.9445	49.28	38.54	5.93
0.9075	57.91	29.37	3.47
0.8700	63.86	21.62	1.52
0.8400	72.26	11.24	0.50

Results at 30° and at 40° (T.).

Wt. per cent Alcohol in Solvent.	At 30°, Gms. NaCl per 100 Gms. Solution.		At 40°, Gms. NaCl per 100 Gms. Solution.	
	Solution.	Water.	Solution.	Water.
0	26.50	36.05	26.68	36.38
5	24.59	34.29	24.79	34.69
10	22.66	32.57	22.90	33.00
20	19.05	29.40	19.46	30.20
30	15.67	26.53	16.02	27.25
40	12.45	23.70	12.75	24.37
50	9.34	20.60	9.67	21.42
60	6.36	16.96	6.65	17.82
70	3.36	12.75	3.87	13.10
80	1.56	7.95	1.69	8.68
90	0.43	4.30	0.50	5.10

100 gms. alcohol of 0.9282 Sp. Gr. = 45.0% by wt. dissolve at.

4°	10°	13°	23°	32°	33°	44°	51°	60°	
10.9	11.1	11.43	11.9	12.3	12.5	13.1	13.8	14.1	gms. NaCl

(Gerardin — Ann. chim. phys. [4] 5, 146, '56.)

100 gms. of a mixture of equal parts of 96% alcohol and 98% ether dissolve 0.11 gm. NaCl.

(Mayer — Liebig's Ann. 98, 205, '56.)

SOLUBILITY OF SODIUM CHLORIDE AT 20° IN AQUEOUS 50 PER CENT ETHYL ALCOHOL CONTAINING INCREASING AMOUNTS OF BENZENE. (Wright, 1926.)

Per cent C ₆ H ₆ in aq. 50% alcohol...	0.0	1.91	4.10	5.34	7.95
Gms. NaCl per 100 gms. sat. sol....	9.80	9.86	9.95	10.10	10.35
100 gms. 86.5% glycerol (<i>d</i> = 1.2326) dissolve	10.37	gms. NaCl at 20°.			
" 98.5% " (<i>d</i> = 1.2645) "	8.28	gms. "			

(Holm, 1921, 1922.)

SOLUBILITY OF SODIUM CHLORIDE IN AQUEOUS SOLUTIONS OF ETHYL ALCOHOL.

(Armstrong and Eyre, 1910-11.)

Results at 0°.			Results at 25°.		
Solvent Gms. C ₂ H ₅ OH per 1000 Gms. H ₂ O.	Gms. NaCl per 100 Gms. Sat. Sol.		<i>d</i> ₂₅ of Sat. Sol.	Solvent Gms. C ₂ H ₅ OH per 1000 Gms. H ₂ O.	Gms. NaCl per 100 Gms. Sat. Sol.
0	26.46		1.202	0	26.55
11.51	25.97		1.196	11.51	26.06
23.03	25.48		1.190	23.03	25.63
46.06	24.41		1.179	46.06	24.75
138.18	20.95		1.159	92.12	23.29
			1.1115	230.3	19.35

SOLUBILITY OF SODIUM CHLORIDE IN AQUEOUS ALCOHOL AT 28°.

(Fontein, 1910.)

Gms. per 100 Gms. Sat. Sol.			Gms. per 100 Gms. Sat. Sol.		
C ₂ H ₅ OH.	H ₂ O.	NaCl.	C ₂ H ₅ OH.	H ₂ O.	NaCl.
0	73.53	26.47	45.35	45.35	9.3
3.8	71.6	24.6	56.2	37.5	6.3
7.7	69.7	22.6	67.4	28.9	3.7
16.1	64.6	19.3	78.8	19.7	1.5
25.3	58.9	15.8	89.6	10	0.4
35	52.5	12.5			

Results are also given by Fontein showing the solubility of sodium chloride in mixtures of ethyl alcohol, amyl alcohol and water at 28°, both when one liquid phase is present and when conjugated liquid layers are formed.

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RECIPROCAL SOLUBILITY OF SODIUM CHLORIDE AND OF SODIUM NITRATE IN AQUEOUS SOLUTIONS OF ETHYL ALCOHOL AT 25°.

(Hering, 1926.)

Gms. per 100 gms. H ₂ O			Solid Phase	Gms. per 100 gms. H ₂ O			Solid Phase
C ₂ H ₅ OH	NaNO ₃	NaCl		C ₂ H ₅ OH	NaNO ₃	NaCl	
25	0.0	28.8	NaCl	72.3	49.2	0.0	NaNO ₃
25	16.1	25.4	"	150	0.0	16.0	NaCl
25	32.2	22.5	"	150	26.9	11.9	" + NaNO ₃
25	47.0	20.3	" + NaNO ₃	150	33.3	0.0	NaNO ₃
25	57.2	10.2	NaNO ₃	255	0.0	10.1	NaCl
25	69.7	0.0	"	255	19.3	8.1	" + NaNO ₃
72.3	0.0	22.4	NaCl	255	22.7	0.0	NaNO ₃
72.3	18.2	19.0	"	396	0.0	6.7	NaCl
72.3	36.3	16.3	" + NaNO ₃	396	13.8	5.2	" + NaNO ₃
72.3	42.2	8.0	NaNO ₃	396	15.4	0.0	NaNO ₃

SOLUBILITY OF SODIUM CHLORIDE IN SEVERAL ALCOHOLS AT 25°.

(Turner and Bissett, 1913.)

Alcohol.	Gms. NaCl per 100 Gms. Alcohol.
Methyl Alcohol, CH ₃ OH	1.31
Ethyl Alcohol, C ₂ H ₅ OH	0.065
Propyl Alcohol, C ₃ H ₇ OH	0.012
Amyl Alcohol, C ₅ H ₁₁ OH	0.002

SOLUBILITY OF SODIUM CHLORIDE IN SEVERAL ALCOHOLS AT 25°.

(Larson and Hunt, 1939.)

Alcohol	Formula	d. of sat. sol.	Gms. NaCl per 100 gms. solvent
Methanol	CH_3OH	0.7977	1.401
Ethanol	$\text{C}_2\text{H}_5\text{OH}$	0.7857	0.0649
1-Propanol	$\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$	0.8000	0.0124
1-Butanol	$\text{CH}_3(\text{CH}_2)_3\text{CH}_2\text{OH}$	0.8058	0.0050
2-Propanol (iso)	$\text{CH}_3\text{CHOHCH}_3$	0.7809	0.0027
2-Methyl-1-propanol (iso butyl)	$(\text{CH}_3)_2\text{CHCH}_2\text{OH}$	0.7980	0.0020
1-Pentanol	$\text{CH}_3(\text{CH}_2)_4\text{CH}_2\text{OH}$	0.0899	0.00177
2-Butanol (Secondary)	$\text{CH}_3\text{CH}_2\text{CHOHCH}_3$	0.8022	0.00047

SOLUBILITY OF SODIUM CHLORIDE IN CONCENTRATED AQUEOUS ETHYL ALCOHOL.

(Ferner and Mellon, 1934.)

Wt. Percent $\text{C}_2\text{H}_5\text{OH}$ in solvent	Gms. NaCl per 100 gms. solvent at:		
	16°	25°	35°
86.4	0.5767	0.6417	0.6586
89.6	0.3711	0.4181	0.4345
92.3	0.2358	0.2670	0.2706
96.9	0.1183	0.1220	0.1335
100.0	0.0657	0.0657	0.0667

SOLUBILITY OF SODIUM CHLORIDE IN SEVERAL ALCOHOLS AT DIFFERENT TEMPERATURES.

(Kirm and Dunlap, 1931.)

Alcohol	Gm. Mols. NaCl per 100 gms mols. alcohol at:					
	20°	30°	35°	40°	45°	50°
Methanol	0.778	0.758	0.744	0.734	0.720	0.711
Ethanol	0.1147	0.1197	0.1242	0.1258	0.1293	0.1142
Propanol	0.00446	0.00434	0.00421	0.00417	0.00384	0.0037
Iso propanol	0.096	0.100	0.108	0.102	0.102	0.093
Butanol	0.00695	0.00710	—	0.00762	—	0.00774
Iso butanol	0.00280	0.00292	—	0.00341	—	0.00356

SOLUBILITY OF SODIUM CHLORIDE IN ANHYDROUS ACETIC ACID.

(Davidson and Chappell, 1932)

t°	Mols. NaCl per 100 mols. sat. sol.	t°	Mols. NaCl per 100 mols. sat. sol.	t°	Mols. NaCl per 100 mols. sat. sol.
30	0.076	54	0.097	76	0.130
41	0.081	60	0.105	84	0.145
45	0.085	68	0.115	92	0.166

SOLUBILITY OF SODIUM CHLORIDE IN AQUEOUS SOLUTIONS OF ETHYLENE GLYCOL AT 30°

(Trimble, 1931.)

d. of sat. sol.	Gms. per 100 gms. sat. sol.		d. of sat. sol.	Gms. per 100 gms. sat. sol.	
	$\text{CH}_2\text{OHCH}_2\text{OH}$	NaCl		$\text{CH}_2\text{OHCH}_2\text{OH}$	NaCl
1.1960	0.0	26.52	1.1593	51.13	13.45
1.1816	14.93	22.14	1.1518	71.97	9.42
1.1694	32.11	17.67	1.1485	93.38	6.62

100 gms. sat. solution of Sodium Chloride in glycol contain 31.7 gms. NaCl at 14.8°. (de Coninck, 1905.)

SOLUBILITY OF SODIUM CHLORIDE IN AQUEOUS SOLUTIONS OF CARBAMIDE
(UREA) AND OF FORMAMIDE AT 25°.

(Ritzel, 1911.)

In Aqueous Carbamide.		In Aqueous Formamide.	
Gms. CO(NH ₂) ₂ per 100 cc. Solution.	Gms. NaCl per 100 cc. Solution.	Gms. HCO.NH ₂ per 100 cc. Solution.	Gms. NaCl per 100 cc. Solution.
0	31.80	0	31.80
5	30.63	2.3	30.98
9.6	29.05	5.3	30.86
13	28.46	8	30.40
18	27.65	11	29.11
23	27.24	15	28.52
28	26.56	18.8	27.76

According to results by Fastert (1912), the solubility of sodium chloride in aqueous solutions of urea increases slightly with increase of urea in solution, thus:

Gms. CO(NH ₂) ₂ per 100 cc. Sol.	10	20	30	40	50
Gms. NaCl per 100 cc. Sol.	31.92	32.17	32.51	32.93	33.40

Data for equilibrium in the system sodium chloride, succinic acid nitrile, water are given by Timmermans (1907).

100 gms. 95% formic acid dissolve 5.8 gms. NaCl at 19.7°. (Aschan, 1913.)

100 gms. hydroxylamine dissolve 14.7 gms. NaCl at 17.5°. (de Bruyn, 1892.)

100 cc. anhydrous hydrazine dissolve 8 gms. NaCl at room temp.
(Welsh and Broderson, 1915.)

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SOLUBILITY OF SODIUM CHLORIDE IN AQUEOUS ACETONE SOLUTIONS AT 20°.
(Frankforter and Cohen, 1914.)

Gms. per 100 Gms. Sat. Sol.			Gms. per 100 Gms. Sat. Sol.		
NaCl.	H ₂ O.	(CH ₃) ₂ CO.	NaCl.	H ₂ O.	(CH ₃) ₂ CO.
25.9	73.06	1.04	16.55	61.59	21.86*
24.19	71.18	4.03	0.45	13.75	85.8*
20.85	66.78	12.37	0.32	13.92	85.76
18.32	63.16	18.52	0.19	10.82	88.99
17.89	62.21	19.90	0.12	8.94	90.94

* Quad pt.

Between the concentration 21.86 and 85.8 per cent acetone, two layers are formed. The binodal curve corresponding to this range of concentration was determined and it is stated by the authors that tie lines were located but the analytical data for them are not given. The results for the binodal curve are as follows:

Gms. per 100 Gms. Homogeneous Liquid.			Gms. per 100 Gms. Homogeneous Liquid.		
NaCl.	H ₂ O.	(CH ₃) ₂ CO.	NaCl.	H ₂ O.	(CH ₃) ₂ CO.
0.59	15.46	83.95	5.87	40.19	53.94
0.79	17.58	81.63	6.45	42.12	51.43
0.93	18.83	80.24	7.53	46.12	46.35
1.27	22.19	76.54	8.87	40.39	41.74
1.57	23.89	74.54	9.47	50.92	39.61
2.31	27.27	70.42	10.35	53.06	36.59
4.87	36.79	58.34	15.87	59.71	24.42

Additional data, showing the effect of temperature on the above system, are also given

SOLUBILITY OF SODIUM CHLORIDE IN AQUEOUS SOLUTIONS OF:

Acetone at 20°.
(Herz and Knoch, 1904.)

cc. Acetone per 100 cc. Solvent.	NaCl per 100 cc. Solution.	
	Millimols.	Gms.
0	537.9	31.47
10	464.6	27.18
20	394.8	23.10
30	330.1	19.32
32 } Lower layer	308.5	18.05
87 } Upper layer	7.7	0.45
88	7.3	0.43
90	4.3	0.25

Glycerol at 25°.
(Herz and Knoch, 1905.)

Wt. Per cent Glycerol in Solvent.	NaCl per 100 cc. Solution.		Sp. Gr. of Solution.
	Millimols.	Gms.	
0	545.6	31.93	1.1960
13.28	501.1	29.31	1.2048
25.98	448.4	26.23	1.2133
45.36	370.2	21.66	1.2283
54.23	333.9	19.54	1.2381
83.84	220.8	12.91	1.2666
100 *	167.1	9.78	1.2964

* Sp. Gr. of Glycerol, 1.2592. Impurities about 1.5%.

1000 cc sat. solution of Sodium Chloride in pure Acetone contain 0.0000055 gm. mol. NaCl at 18° and 0.000006 gm. mol. at 37°, as determined by electrical conductivity measurements. (Lannung, 1932.)

EQUILIBRIUM IN THE SYSTEM SODIUM CHLORIDE, METHYL ETHYL KETONE AND WATER AT 25° (BINODAL CURVE).

(Frankforter and Cohen, 1916.)

Gms. per 100 Gms. Homogeneous Liquid.	Gms. per 100 Gms. Homogeneous Liquid.		
	NaCl.	CH ₃ .CO.C ₂ H ₅ .	H ₂ O.
0.35	20.13	79.52	6.75
0.55	19.75	79.70	10.07
1.42	16.52	82.06	14.32
1.80	17.70	80.50	14.65
2.47	16.24	81.29	23.15
4.11	13.34	82.55	24.14
			0.94
			74.77
			74.92

SOLUBILITY OF SODIUM CHLORIDE IN AQUEOUS PROPYL ALCOHOL.

(Armstrong and Eyre, 1910-11.)

Aqueous propyl alcohol containing 15.01 gms. C₃H₇OH per 1000 cc. H₂O dissolves 25.71 gms. NaCl per 100 gms. sat. solution at 0° and 25.95 gms. at 25°.

Aqueous propyl alcohol containing 30.02 gms. C₃H₇OH per 1000 cc. H₂O dissolves 25.12 gms. NaCl per 100 gms. sat. solution at 0° and 25.37 gms. at 25°.

EQUILIBRIUM IN THE SYSTEM SODIUM CHLORIDE, NORMAL PROPYL ALCOHOL AND WATER AT 23-25°.

(Frankforter and Frary, 1913.)

The authors determined the binodal curve and quadruple points of the system but did not locate tie lines.

Gms. per 100 Gms. Homogeneous Liquid.			Gms. per 100 Gms. Homogeneous Liquid.		
NaCl.	C ₃ H ₇ OH.	H ₂ O.	NaCl.	C ₃ H ₇ OH.	H ₂ O.
0.55	87.7	11.75*	14.38	5.39	80.23
2.23	51.57	46.20	15.42	5.11	79.47
3.55	18.99	77.46	16.38	4.47	79.14
3.90	14.78	81.32	18.08	3.83	78.09
5.27	12.77	81.96	20.12	3.27	76.61
8.04	9.40	82.47	22.35	2.64	75.01
10.49	7.79	81.72	24.50	2.13	73.37
12.20	6.57	81.23	24.9	2.3	72.8*

* Quad. pt.

The effect of temperature upon the equilibrium in the above system was greater than observed in any of the other systems investigated and additional data, illustrating the extent of the temperature influence, are given.

100 gms. sat. sol. of NaCl in 99.6 per cent C₃H₇OH contain 0.04 gm. NaCl at 25°.

(Frankforter and Frary, 1913.)

SODIUM CHLORIDE

SOLUBILITY OF SODIUM CHLORIDE IN CONCENTRATED SOLUTIONS OF
2-PROPANOL (ISO PROPYL ALCOHOL) IN WATER.

(Ferner and Mellon, 1934.)

Wt. Percent $\text{CH}_3\text{CH}_2\text{OHCH}_3$ in solvent	Gms. NaCl per 100 gms. solvent at:		
	15°	25°	35°
87.7	0.2650	0.2812	0.2968
92.6	0.0647	0.0630	0.0701
96.5	0.0169	0.0161	0.0183
100.0	0.0040	0.0041	0.0030

SOLUBILITY OF SODIUM CHLORIDE IN ISO PROPYL ALCOHOL
CONTAINING SMALL AMOUNTS OF WATER AT 25°.

(Kraus and Seward, 1928.)

d. of solvent	% H_2O in solvent	Gm. mols. NaCl per liter solvent	d. of solvent	% H_2O in solvent	Gm. mols. NaCl per liter solvent
0.7849	0.0	0.0004246	0.7885	1.39	0.0008025
0.7854	0.084	0.0004399	0.7900	2.02	0.001100
0.7868	0.815	0.0006034	0.7985	5.88	0.004138

SOLUBILITY OF SODIUM CHLORIDE IN ISO PROPYL ALCOHOL CONTAINING
INCREASING AMOUNTS OF SODIUM NITRATE AT 25°.

(Kraus and Seward, 1927, 1928.)

Gm. Mols. per liter		Gm. Mols. per liter		Gm. Mols. per liter	
NaNO_3	NaCl	NaNO_3	NaCl	NaNO_3	NaCl
0.00	0.0004246	0.0005907	0.0003625	0.0015574	0.0003244
0.00008	0.0004159	0.0005984	0.0003640	0.001959	0.0003074
0.0001672	0.0004050	0.0008539	0.0003480	0.002824	0.0002903
0.0004013	0.0003817	0.0013097	0.0003242		

The authors also give results for the Solubility of Sodium Chloride in Iso propyl Alcohol containing 2.02 percent H_2O and increasing amounts of Sodium Nitrate at 25°.

SOLUBILITY OF SODIUM CHLORIDE IN ISO PROPYL ALCOHOL
CONTAINING INCREASING AMOUNTS OF AMMONIUM NITRATE AT 25°.

(Kraus and Seward, 1927, 1928.)

Gm. Mols. per liter		Gm. Mols. per liter	
NH_4NO_3	NaCl	NH_4NO_3	NaCl
0.000	0.000455	0.0003537	0.000547
0.0000985	0.000481	0.0006938	0.000617
0.0001839	0.000503	0.0014024	0.000734

SODIUM CHLORIDE

EQUILIBRIUM IN THE SYSTEM SODIUM CHLORIDE, Iso PROPYL
ALCOHOL AND WATER AT 25°.
(Ginnings and Chen, 1931.)

Points on the binodal curve of this system were determined by observing the appearance or disappearance of clouding in a mixture of weighed amounts of NaCl and one of the liquids, upon addition of weighed amounts of the other. Tie lines, *, were located by determination of NaCl in two liquid layers in contact with each other and the plait point, PP, was found by plotting.

Gms. per 100 gms. of the three constituents		Gms. per 100 gms. of the three constituents	
NaCl	$\text{CH}_3\text{CH}_2\text{OHCH}_3$	NaCl	$\text{CH}_3\text{CH}_2\text{OHCH}_3$
1.70	75.20*	10.62	23.90
2.95	64.35	13.70	15.70
5.20	49.50 PP	21.10	5.9 *
10.17	25.45		

Cl 100 gms. normal Butyl Alcohol ($\text{CH}_3(\text{CH}_2)_2\text{CH}_2\text{OH}$) of d. = 0.806
dissolve 0.014 gm. NaCl at 25°. (Willard and Smith, 1922, 1923.)

EQUILIBRIUM IN THE SYSTEM SODIUM CHLORIDE, TERTIARY BUTYL ALCOHOL
AND WATER AT 30°.
(Ginnings and Robbins, 1930.)

The determinations were made as noted above.

Gms. per 100 gms. of the three constituents		Gms. per 100 gms. of the three constituents		Gms. per 100 gms. of the three constituents	
NaCl	$(\text{CH}_3)_3\text{COH}$	NaCl	$(\text{CH}_3)_3\text{COH}$	NaCl	$(\text{CH}_3)_3\text{COH}$
0.0	84.0*	4.3	27.7	10.7	—
0.3	83.8	4.5	26.0	11.2	8.5
—	60.0*	4.6	23.0 PP	12.5	7.5
1.5	57.3	5.1	19.0	13.9	—
—	48.0*	6.7	14.5	14.1	6.7
2.4	44.4	9.0	11.5	15.6	5.8
3.2	36.4	10.0	10.0	18.4	4.2
				22.4	—

The plait point PP, at 25° was found by Ginnings, Herring and Webb, 1933, to have the composition - 3.7 percent NaCl + 36.7 percent $(\text{CH}_3)_3\text{COH}$ + 59.6 percent H_2O . The original results for the remaining points on the binodal curve are not given but only the values of arbitrary constants derived by empirical equations.

EQUILIBRIUM IN THE SYSTEM SODIUM CHLORIDE, BUTYRIC ACID
AND WATER AT 25°.
(Bury and Mends, 1939.)

The mixtures separate into two liquid layers at concentrations of butyric acid between 1.47 and 85.25 percent.

Results for Solutions in
contact with NaCl

Gms. per 100	gms. sat. sol.
$C_4H_8O_2$	NaCl
0.0	26.45
0.22	26.30
0.68	26.05
1.30	25.76
1.47	25.68
89.25	0.12
90.37	0.11
93.27	0.07
94.06	0.06
97.44	0.03
99.98	0.02

Results for mixtures yielding
two liquid layers

Upper Layer		Lower Layer	
Gms. per 100	gms. sat. sol.	Gms. per 100	gms. sat. sol.
$C_4H_8O_2$	NaCl	$C_4H_8O_2$	NaCl
34.86	1.90	32.70	2.0
36.50	1.69	31.75	2.07
38.73	1.58	28.90	2.20
41.50	1.49	27.10	2.26
44.78	1.42	22.76	2.50
50.78	1.35	18.64	3.20
60.42	0.9	12.62	4.44
70.20	0.85	7.76	10.15
76.38	0.65	5.65	14.05
85.65	0.50	3.00	21.15
88.12	0.31 (tr.pt.)	1.77	25.48

EQUILIBRIUM IN THE SYSTEM SODIUM CHLORIDE, ISO BUTYRIC
ACID AND WATER AT 25°.
(Bury and Mends, 1939.)

Results for solutions in
contact with NaCl

Gms. per 100	gms. sat. sol.
iso $C_4H_8O_2$	NaCl
0.24	26.31
0.73	26.11
1.17	25.88
95.53	0.06
96.24	0.04
98.24	0.03
99.99	0.01

Results for mixtures yielding
two liquid layers

Gms. per 100	gms. sat. sol.	Gms. per 100	gms. sat. sol.
iso $C_4H_8O_2$	NaCl	iso $C_4H_8O_2$	NaCl
57.26	0.0	24.10	0.0
69.34	0.10	15.80	1.25
78.40	0.11	10.80	3.95
86.86	0.14	5.59	10.63
90.10	0.14	3.67	15.54
94.13	0.14	2.43	20.88
94.78	0.14 (tr.pt.)	1.40	25.77

Cl

EQUILIBRIUM IN THE SYSTEMS SODIUM CHLORIDE, ALLYL ALCOHOL, WATER, AT
20° AND SODIUM CARBONATE, ALLYL ALCOHOL, WATER, AT 20°.
(Frankforter and Temple, 1915.)

Results for
NaCl + $CH_2:CHCH_2OH + H_2O$.
Gms. per 100 Gms. Alcohol + Water.

NaCl.	Alcohol.	Water.
3.509	69.867	30.133
4.452	64.858	33.142
5.079	60.821	30.179
6.712	54.683	45.317
8.776	47.132	52.868
10.650	40.392	59.608
12.535	33.224	66.776
14.925	27.261	72.730
18.557	19.705	80.295

Results for
 $Na_2CO_3 + CH_2:CHCH_2OH + H_2O$.
Gms. per 100 Gms. Alcohol + Water.

Na_2CO_3 .	Alcohol.	Water.
0.456	61.112	38.888
0.708	56.334	43.666
1.011	51.930	48.070
1.468	48.109	51.891
2.580	41.052	58.948
3.414	37.126	62.874
4.739	32.166	67.834
7.774	23.753	76.247
10.079	18.407	81.593

SODIUM CHLORIDE

The binodal curve for the System Sodium Chloride, Allyl Alcohol and Water at 25° has been determined by Ginnings and Dees, 1935, but the authors do not give their experimental results but only the values of a series of arbitrary constants calculated by means of an empirical equation. From these the conclusion is drawn that allyl alcohol seems to be more difficult to salt out than either normal or iso propyl alcohol.

EQUILIBRIUM IN THE SYSTEM SODIUM CHLORIDE, DIOXAN AND WATER AT 25°.
(Herz and Lorentz, 1929.)

Vol. percent $C_4H_8O_2$ in solvent	Gm. Mol. NaCl per liter of solution
10	4.70
20	4.00
30	3.68

Between 23 and 85 Vol. percent Dioxan the mixtures separate into two liquid layers. The lower, H_2O rich layer, contains 3.28 gm. mol. NaCl per liter and the upper, dioxan rich layer, contains 0.01 gm. mol. NaCl per liter.

Cl

SOLUBILITY OF SODIUM CHLORIDE IN AQUEOUS SOLUTIONS OF
TARTARIC ACID AT 25°.

(Herz and Hiebenthal, 1929.)

Gms. per liter		Solid Phase	Gms. per liter		Solid Phase
$C_4H_6O_6$	NaCl		$C_4H_6O_6$	NaCl	
0.0	314.5	NaCl	242.0	283.5	NaCl
92.0	308.7	"	630.0	229.7	"
161.0	298.1	"	733.0	216.3	" + $C_4H_6O_6$

EQUILIBRIUM IN THE SYSTEM SODIUM CHLORIDE ETHYL URETHAN
AND WATER AT 25°.

(Palitzsch, 1928, 1929.)

Gm. Mols. per 1000 gms. H_2O		Solid Phase	Gm. Mols. per 1000 gms. H_2O		Solid Phase
NaCl	$NH_2COOC_2H_5$		NaCl	$NH_2COOC_2H_5$	
6.12	0.0	NaCl	2.20	21.78	Upper liquid layer
6.12	0.1123	"	4.65	1.785	$NH_2COOC_2H_5$
5.96	0.5612	"	3.55	3.531	"
5.86	1.119	" + $NH_2COOC_2H_5$	1.0	39.0	"
3.21	5.187	Lower liquid layer	0.0	53.09	"

100 cc sat. solution of Sodium Chloride in Ethyl Urethan contain 0.132 gm. NaCl at 60°. (Stuckgold, 1917.)

The binodal curve and plait point of the system Sodium Chloride, Pyridine and Water at 25° has been determined by Ginnings, Webb and Hinohara, 1933, but the authors do not give their experimental results but only the values of a series of constants calculated by means of empirical equations.

SOLUBILITY OF SODIUM CHLORIDE IN AQUEOUS SOLUTIONS OF SUCROSE AT 25°
AND VICE VERSA. (Schoorl, 1923.)

Gms. per 100 gms. sat. sol.		Solid Phase.	Gms. per 100 gms. sat. sol.		Solid Phase.
Na Cl.	C ₁₂ H ₂₂ O ₁₁		Na Cl.	C ₁₂ H ₂₂ O ₁₁	
23.3	12.7	Na Cl	8.6	62.2	1.1.2 + C ₁₂ H ₂₂ O ₁₁
17.5	36.7	"	11.5	61.7	Na Cl + "
16.2	43.0	" + 1.1.2	6.15	63.0	C ₁₂ H ₂₂ O ₁₁
9.75	57.0	1.1.2	1.62	66.0	"
1.1.2 = NaCl.C ₁₂ H ₂₂ O ₁₁ .2H ₂ O.					

The author also gives very complete vapor tension data for this system.

100 gms. H₂O dissolve 236.3 gms. sugar + 42.3 gms. NaCl at 31.25°, or 100 gms. sat. aq. solution contain 62.17 gms. sugar + 11.13 gms. NaCl. (Köhler, 1897.)

C1

EQUILIBRIUM IN THE SYSTEM SODIUM CHLORIDE, GLUCOSE
AND WATER AT 24°.
(Matsuura, 1927.)

Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase
C ₆ H ₁₂ O ₆	NaCl		C ₆ H ₁₂ O ₆	NaCl	
0.0	26.46	NaCl	36.90	14.50	1.2.1
2.84	25.87	"	38.67	13.61	"
5.21	25.28	"	41.62	11.92	"
9.90	24.10	"	44.05	10.95	"
13.09	23.38	"	47.35	9.57	" + C ₆ H ₁₂ O ₆ .11.2O
19.77	21.90	"	47.23	8.28	C ₆ H ₁₂ O ₆ .11.2O
23.87	20.83	"	47.73	7.65	"
27.81	19.87	"	47.74	6.97	"
29.47	19.50	" + 1.2.1	48.08	5.60	"
31.70	18.10	1.2.1	48.12	4.04	"
33.74	16.87	"	48.55	2.49	"
34.92	15.98	"	48.68	0.00	"

1.2.1 = NaCl.2[C₆H₁₂O₆].H₂O.

SOLUBILITY OF SODIUM CHLORIDE IN LIQUID AMMONIA.

(Patscheke, 1933.)

The authors results were plotted and the following values taken from the curve. The results of Johnson and Krombolitz, 1933; Scherer, Jr., 1931; Linhard and Stephan, 1933, 1934; and Portinow and Rawdine, 1937, agree in general with those of Patscheke. The results of Hunt, 1932, at 25° are apparently too low.

t°	Gms. NaCl per 100 gms. sat. sol.	Solid Phase	t°	Gms. NaCl per 100 gms. sat. sol.	Solid Phase
-76.3	0.0	NH ₃	-10	14.5	NaCl.5NH ₃
-76.6	0.28	" + NaCl.5NH ₃	-8.5	16.3*	"
-70.0	0.4	NaCl.5NH ₃	-9.5	15.4	"
-60.0	0.55	"	-11.5	16.3*	" + NaCl
-50	1.15	"	-5.0	13.4	NaCl
-40	2.10	"	0	11.5	"
-30	4.0	"	+10	7.85	"
-20	7.5	"	20	5.3	"
-15	10.6	"	30	3.2	"
-12.5	12.6	"	40	2.0	"
			45	1.6	"

* Metastable.

Data for the isotherms of the System NaCl + NH₄Cl + NH₃ at -10°, 0° and +10° are given by Patscheke and Tanne, 1935. They also give results for the solution temperatures of mixtures in various ratios of NaCl and NH₄Cl as compared with the solution temperature of each salt separately.

EQUILIBRIUM IN THE SYSTEM SODIUM CHLORIDE, SODIUM NITRATE AND LIQUID AMMONIA AT 0°.

(Portinow and Rawdine, 1937.)

Gms. per 100 gms. sat. sol.			Solid Phase	Gms. per 100 gms. sat. sol.			Solid Phase
NaCl	NaNO ₃	NH ₃		NaCl	NaNO ₃	NH ₃	
11.60	0.0	88.40	NaCl	4.32	31.07	64.61	NaCl
10.76	3.51	85.73	"	2.21	41.60	56.19	"
9.34	11.30	79.30	"	0.95	49.64	49.41	"
7.41	18.77	73.82	"	0.92	50.70	48.38	"
6.79	21.96	21.25	"	0.83	55.12	44.05	"
6.43	22.80	20.77	"	0.0	56.04	43.95	"

SOLUBILITY OF SODIUM CHLORIDE IN LIQUID AMMONIA CONTAINING INCREASING AMOUNTS OF SODIUM NITRATE.

(Guyer, Bieler and Schmid, 1934.)

The results are presented only in the form of a diagram from which the following approximate values were read.

t°	Gms. NaCl per 100 gms. sat. solution in Liquid Ammonia Containing:				
	0% NaNO ₃	10% NaNO ₃	20% NaNO ₃	30% NaNO ₃	40% NaNO ₃
-30	4.3	4.2	4.1	3.5	3.0
-20	8.0	7.5	7.2	6.0	4.5 (-21°)
-9.5	15.4	12.0 (-10°)	9.5 (-11°)	7.2 (-13°)	3.0
0	11.2	9.0	7.0	4.5	2.0
+10	7.5	6.5	4.5	3.5	2.0
20	5.0	4.2	3.0	3.0	2.0

EQUILIBRIUM IN THE SYSTEM SODIUM CHLORIDE, SODIUM
NITRATE AND LIQUID AMMONIA AT 25°.

(Hunt and Boncyk, 1933.)

0.25 gm. of the less soluble salt was mixed with variable amounts of the more soluble salt and ammonia added in excess. Ammonia was then allowed to escape from the solution until a single crystal of salt separated from solution. Identical results were obtained by approaching the saturation point from opposite sides.

Gm. Mols. per 100 gms. Mols. NH_3		Gm. Mols. per 100 gms. Mols. NH_3	
NaCl	NaNO_3	NaCl	NaNO_3
0.088	0.0	0.0686	1.694
0.087	0.46	0.0590	1.787
0.0746	1.232	0.0524	1.80
0.0700	1.482	0.0	1.95

100 gms. liquid Sulfur Dioxide dissolve 0.016 gm. NaCl at 0°.

(Jander and Wickert, 1936; Jander & Ruppolt, 1937.)

100 gms. sat. solution of Sodium Chloride in Selenium Oxy Chloride (SeOCl_2) contain 0.57 gm. NaCl at 25°. (Wise, 1923.)

Fusion-point data are given for:

- NaCl + Na_2CrO_4 (Sackur, 1911-12.)
 " + NaF (Ruff and Plato, 1903; Walters, 1910; Plato, 1907.)
 " + NaOH (Scarpa, 1915.)
 " + NaI (Ruff and Plato, 1903; Amadori, 1912a.)
 " + NaNO_2 (Meneghini, 1912.)
 " + $\text{Na}_2\text{P}_2\text{O}_7$ (LeChatilier, 1894.)
 " + Na_2SO_4 (Ruff and Plato, 1903; Jänecke, 1908; Wolters, 1910; Sackur, 1911-12.)
 " + SrCl_2 (Vortisch, 1914; Sackur, 1911-12; Scholich, 1920.)
 " + SrCO_3 (Sakur, 1911-12.)
 " + TlCl_3 (Sandonnini, 1911, 1914.)

SODIUM HYPOCHLORITE $\text{NaClO} \cdot 5\text{H}_2\text{O}$.

SOLUBILITY OF SODIUM HYPOCHLORITE IN WATER, DETERMINED BY THE
FREEZING-POINT METHOD. (Sanfourche and Gardnet, 1924.)

Gms. NaClO per 100 gms. sat. sol.			Gms. NaClO per 100 gms. sat. sol.		
t°.		Solid Phase.	t°.		Solid Phase.
-2.6....	5.0	Ice	23.0....	39.0	$\text{NaClO} \cdot 5\text{H}_2\text{O}$
-7.0....	10.0	"	24.0....	42.0	"
-12.0....	15.0	"	24.5 m. pt.	44.0	"
-16.6....	19.2	Ice + $\text{NaClO} \cdot 5\text{H}_2\text{O}$	24.0....	46.0	"
-12.0....	20.6	$\text{NaClO} \cdot 5\text{H}_2\text{O}$	23.0 tr. pt.	48.5	$\text{NaClO} \cdot 5\text{H}_2\text{O} + \text{NaClO} \cdot 2.5\text{H}_2\text{O}$
0....	22.7	"	30.0....	50.0	$\text{NaClO} \cdot 2.5\text{H}_2\text{O}$
+10.0....	26.7	"	40.0....	52.5	"
15.0....	30.6	"	50.0....	56.5	"
20.....	34.8	"	56.0....	61.2	"

SODIUM CHLORATE NaClO_3 .**SOLUBILITY IN WATER.**

(Carlson, 1910; Le Blanc and Schmandt, 1911; Osaka, 1903-08.)

t°.	d of Sat. Sol.	Gms. NaClO_3 per 100 Gms. H_2O .	t°.	d of Sat. Sol.	Gms. NaClO_3 per 100 Gms. H_2O .
-15	1.380	72	40	1.472	126 (115 Le B. & S.)
0	1.389	79 (80 Le B. & S.)	50	...	140 (126 "
10	...	89 (87 "	60	1.514	155
15	1.419	95 (91 "	70	...	172
20	1.430	101 (95.7 "	80	1.559	189
25	1.44	106 (101 O.)	100	1.604	230
30	...	113 (105 Le B. & S.)	122 (b. pt.)	1.654	286

SOLUBILITY OF SODIUM CHLORATE IN WATER.**Results of Billiter, 1920.**

t°.	Gms. NaClO_3 per 100 cc. sat. sol.	t°.	Gms. NaClO_3 per 100 cc. sat. sol.
20....	72.2	70....	96.0
30....	77.0	80....	100.2
40....	82.0	90....	106.0
50....	86.6	100....	111.0
60....	91.3		

Results of Bell, 1923.

t°.	Gms. NaClO_3 per 100 gms. sat. sol.	t°.	Gms. NaClO_3 per 100 gms. sat. sol.
0....	44.32	30....	51.30
10....	46.70	35....	52.38
20....	48.95	40....	53.54
25....	50.13	100....	67.10

Saturation was secured in both cases by constant agitation in a thermostat.

C10 SOLUBILITY OF SODIUM CHLORATE IN AQUEOUS SOLUTIONS OF SODIUM CHLORIDE (Billiter, 1920.)

t°	Gms. NaClO_3 per 100 cc. sat. solution in		
	Aq. 10 % NaCl .	Aq. 20 % NaCl .	Aq. 32 % NaCl .
20.....	66	57.4	41.8
40.....	75	65	42
60.....	83.5	70	42.4
80.....	92	77	43.3
100.....	102	87	44

SOLUBILITY OF SODIUM CHLORATE IN AQUEOUS SODIUM CHLORIDE SOLUTIONS AT 20°.

(Winteler, 1900.)

Sp. Gr. of Solutions.	Gms. per Liter.		Sp. Gr. of Solutions.	Gms. per Liter.	
	NaCl .	NaClO_3 .		NaCl .	NaClO_3 .
1.426	5	668	1.365	175	393
1.419	25	638	1.345	200	338
1.412	50	599	1.319	225	271
1.405	75	559	1.289	250	197
1.398	100	522	1.256	275	120
1.389	125	484	1.235	290	78
1.379	150	442	1.217	300	55

100 gms. H_2O dissolve 24.4 gms. NaCl + 50.75 gms. NaClO_3 at 12°.100 gms. H_2O dissolve 11.5 gms. NaCl + 249.6 gms. NaClO_3 at 122°. (Schlosing, 1871.)

SODIUM CHLORATE

EQUILIBRIUM IN THE SYSTEM SODIUM CHLORATE, SODIUM SULFATE AND WATER.

(Ricci and Yanick, 1937.)

d. of sat. sol.	Gms. per 100 NaClO ₃	gms. sat. sol. Na ₂ SO ₄	Solid Phase	Gms. per 100 NaClO ₃	gms. sat. sol. Na ₂ SO ₄	Solid Phase
Results at 15°				Results at 25° (con.)		
1.406	47.91	0.0	NaClO ₃	23.45	12.64	Naro
1.423	45.86	2.19	"	18.05	13.90	"
1.422	44.34	3.83	"	12.30	15.77	"
—	42.66	5.59*	"	6.58	18.20	"
1.424	41.85	6.44*	" + Na	0.0	21.78	"
1.393	35.93	8.91*	Na	Results at 45°		
1.422	44.12	4.06	NaClO ₃ + Na ₁₀			
—	43.07	3.89	Na ₁₀			
1.372	39.37	4.02	"	54.59	0.0	NaClO ₃
1.323	34.75	4.06	"	53.10	1.77	" + 1.3
1.200	19.86	5.52	"	50.22	2.40	1.3
1.106	0.0	11.60	"	40.14	5.85*	"
Results at 25°				28.23	12.66*	"
				20.10	18.68*	"
				51.46	2.38*	Na
50.14	0.0	NaClO ₃		49.71	2.57	" + 1.3
47.62	2.80	"		45.88	3.55	"
46.64	3.86*	" + Na		36.12	6.87	"
46.62	3.87	" + 1.3		17.88	17.52	"
44.10	4.76*	1.3		0.0	32.08	"
39.75	6.70*	"		Results at 75°		
34.36	9.61*	"				
30.80	11.90*	"		61.40	0.0	NaClO ₃
25.26	15.72*	"		60.73	1.0	" + 1.3
46.31	4.01	" + Na		58.34	1.37	1.3
44.76	4.60	Na		56.25	1.62	"
38.07	7.21	"		52.84	1.94*	"
32.47	9.86	"		46.82	3.27*	"
28.02	12.53*	"		41.42	5.11*	"
17.09	19.89*	"		57.81	1.61*	Na
6.03	28.62*	"		55.71	1.52	" + 1.3
0.0	33.97*	"		51.85	2.09	"
29.90	12.26*	1.3 + Na ₁₀		45.51	3.19	"
29.52	12.20*	Na ₁₀		27.19	10.56	"
28.90	12.12	" + Na		6.26	24.70	"
27.36	12.06	Na ₁₀		0.0	30.33	"

* = Metastable; Na = Na₂SO₄; Na₁₀ = Na₂SO₄·10H₂O; 1.3 = NaClO₃·3Na₂SO₄.

Results for this system at 0°, 20° and 40° are given by Babaew, 1936, but the author failed to find the double salt, NaClO₃·3Na₂SO₄, or trace the metastable portions of the curves.

Na NARIUM SODIUM CHLORATE

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EQUILIBRIUM IN THE SYSTEM SODIUM CHLORATE, SODIUM IODATE AND WATER.
(Ricci, 1938.)

Results at 25°

Results at 50°

d. of sat. sol.	Gms. per 100 NaIO ₃	gms. sat. sol. NaClO ₃	Solid Phase	Gms. per 100 NaIO ₃	gms. sat. sol. NaClO ₃	Solid Phase
—	0.0	50.14	NaClO ₃	0.0	55.74	NaClO ₃
1.444	1.16	49.52	"	1.26	54.98	"
1.444	1.29	49.38	" + NaIO ₃ ·H ₂ O	1.69	54.71	" + NaIO ₃
1.440	1.30	49.19	NaIO ₃ ·H ₂ O	1.75	53.83	NaIO ₃
1.425	1.33	48.13	"	2.14	47.86	"
1.404	1.39	46.27	"	2.2	45.0	" + NaIO ₃ ·H ₂ O
1.396	1.46	44.56	"	2.50	43.4*	"
—	1.52	42.99	"	1.87	54.59	NaClO ₃ + "
1.332	1.69	38.66	"	1.92	53.20*	NaIO ₃ ·H ₂ O
1.273	1.97	32.57	"	2.12	48.95*	"
1.204	2.43	24.67	"	2.41	43.71	"
1.146	3.14	16.50	"	3.23	33.33	"
1.098	4.51	8.36	"	5.69	16.56	"
1.075	8.57	0.0	"	7.67	10.02	"
				13.49	0.0	"

* = Metastable.

C10

SOLUBILITY OF SODIUM CHLORATE IN AQUEOUS ETHYL ALCOHOL.
(Carlson, 1910.)

t°.	Gms. NaClO ₃ per Liter of Sat. Sol. in Aqueous Alcohol of:		
	50 Per cent.	75 Per cent	90 Per cent.
20	313.3	110.8	16.1
40	321.8	133.5	22.9
60	326.8	155.8	29
70	...	161.3	...

100 gms. alcohol of 77 Wt. per cent dissolve 2.9 gms. NaClO₃ at 16°. (Wittstein.)

100 gms. alcohol dissolve 1 gm. NaClO₃ at 25°, and 2.5 gms. at b. pt.

100 gms. glycerol dissolve 20 gms. NaClO₃ at 15.5°. (Ossendowski, 1907.)

100 cc. anhydrous hydrazine dissolve 66 gms. NaClO₃ at room temperature.

(Welsh and Broderson, 1915.)

SODIUM Per CHLORATE NaClO₄·H₂O.

SOLUBILITY OF SODIUM PERCHLORATE IN WATER.

(Cornec and Dickely, 1927.)

t°	d. of sat. sol.	Gms. NaClO ₄ per 100 gms. sat. sol.	Solid Phase	t°	d. of sat. sol.	Gms. NaClO ₄ per 100 gms. sat. sol.	Solid Phase
0	—	62.87	NaClO ₄ ·H ₂ O	25	1.757	73.21*	NaClO ₄
15	1.663	65.63	"	38	1.757	72.83*	"
25	1.683	67.82	"	55	1.756	73.94	"
38	1.713	70.38	"	75	1.757	75.01	"
50	1.749	73.26	"	100	1.758	76.75	"
15	1.758	71.68*	NaClO ₄	143	1.789	79.03(1)	"

* Metastable; (1) Carlson, 1910. The results of this author at 15° and 50° are considered too low.

SOLUBILITY OF SODIUM PERCHLORATE IN WATER. (Freeth, 1924.)

Saturation was secured by constant agitation in a thermostat.

t°.	Gms. NaClO ₄ per 100 gms. sat. sol.	Solid Phase.	t°.	Gms. NaClO ₄ per 100 gms. sat. sol.	Solid Phase.
-3.0...	10.00	Ice	15.0...	65.51	NaClO ₄ ·H ₂ O
-6.8...	20	"	30.0...	68.71	"
-11.1...	30	"	40.0...	70.88	"
-17.8...	40	"	50.0...	73.16	"
-22.0...	45	"	50.8...	73.3	" + NaClO ₄
-32.0...	56	Ice + NaClO ₄ ·H ₂ O	60.0...	74.3	NaClO ₄
0.0...	69.64	NaClO ₄ ·H ₂ O	75.0...	75.0	"

EQUILIBRIUM IN THE SYSTEM SODIUM PERCHLORATE, SODIUM CHLORIDE AND WATER.
(Cornec and Dickely, 1927.)

t°	d. of sat.	Gms. per 100 gms. sat. sol.	Solid Phase	t°	d. of sat.	Gms. per 100 gms. sat. sol.	Solid Phase
		NaClO ₄ NaCl				NaClO ₄ NaCl	
0	—	62.87	0 NaClO ₄ ·H ₂ O	55	1.755	73.00	0.78 NaCl+NaClO ₄
"	—	59.69	2.53 " + NaCl	75	1.757	74.15	0.83 " + "
"	—	52.82	4.37 NaCl	100	1.758	76.75	0.0 NaClO ₄
"	—	40.65	8.63 "	"	1.757	75.79	0.88 " + NaCl
"	—	23.86	15.44 "	"	1.664	69.32	1.44 NaCl
25	1.683	66.58	1.37 " + NaClO ₄ ·H ₂ O	"	1.532	59.23	3.06 "
38	1.723	69.41	1.05 " " " " "	"	1.367	41.44	8.81 "
50	1.749	72.46	0.81 " " " " "				

EQUILIBRIUM IN THE SYSTEM SODIUM PERCHLORATE, SODIUM SULFATE AND WATER
AT 35° AND AT 60°. (Freeth, 1924.)

Results at 25°.

Gms. per 100 gms. sat. sol.	Solid Phase.
NaClO ₄ Na ₂ SO ₄	
67.60 0.0	NaClO ₄ ·H ₂ O
67.67 0.26	" + Na ₂ SO ₄
53.58 1.24	Na ₂ SO ₄
41.68 4.28	"
31.24 9.07	Na ₂ SO ₄ + Na ₂ SO ₄ ·10H ₂ O
18.72 12.56	Na ₂ SO ₄ ·10H ₂ O
5.79 18.15	"
0.0 21.71	"

Results at 60°.

Gms. per 100 gms. sat. sol.	Solid Phase.
NaClO ₄ Na ₂ SO ₄	
74.30 0.0	NaClO ₄
74.40 0.29	" + Na ₂ SO ₄
64.65 0.37	Na ₂ SO ₄
52.47 1.11	"
31.55 6.95	"
17.70 14.90	"
0.0 31.90	"

The author also gives complete data for the quaternary equilibria in the system NaClO₄ + (NH₄)₂SO₄ + NH₄ClO₄ + Na₂SO₄ + H₂O at 25° and at 60°.

SOLUBILITY OF ANHYDROUS SODIUM PERCHLORATE IN SEVERAL SOLVENTS AT 23°. (Willard and Smith, 1923.)

Solvent.	d_{23}^4 of sat. sol.	Gms. NaClO ₄ per 100 gms. sat. sol.	Solvent.	d_{23}^4 of sat. sol.	Gms. NaClO ₄ per 100 gms. sat. sol.
Water.....	1.6821	67.70	<i>n</i> Butyl alcohol....	0.8167	1.83
Methyl alcohol...	1.0561	33.93	<i>iso</i> "	0.8031	0.78
Ethyl alcohol....	0.8685	12.82	Acetone.....	1.0732	34.10
<i>n</i> Propyl alcohol.	0.8308	4.66	Ethyl acetate.....	0.9574	8.80

SOLUBILITY OF SODIUM PERCHLORATE IN NORMAL BUTYL ALCOHOL CONTAINING INCREASING PERCENTAGES OF PERCHLORIC ACID AT 23° ± 3° AND AT THE BOILING-POINT. (Smith, 1923 a.)

The results are given only in the form of a diagram, from which the following approximate values were read.

Gms. HClO ₄ ·2H ₂ O per 100 gms. solvent.	Gms. NaClO ₄ per 100 gms. sat. sol. at 23° ± 3°.	b. pt.	Gms. HClO ₄ ·2H ₂ O per 100 gms. solvent.	Gms. NaClO ₄ per 100 gms. sat. sol. at 23° ± 3°.	b. pt.
0.0 (= <i>n</i> -butyl alc.)...	2.8	7.5	0.6.....	3.05	8.2
0.2.....	2.9	7.8	0.8.....	3.0	8.35
0.4.....	3.0	8.0	1.0.....	2.8	9.0

SOLUBILITY OF ANHYDROUS SODIUM PERCHLORATE IN MIXTURES OF ETHYL ACETATE AND ALCOHOLS AT 25° ± 0.1. (Smith, 1925.)

	Gms. NaClO ₄ per 100 gms. sat. sol. in solvent composed of ethyl acetate and					
Volume % alcohol in solvent.	Methyl alcohol.	Ethyl alcohol.	93% Ethyl alcohol.	<i>n</i> Butyl alcohol.	<i>n</i> Butyl* alcohol.	Ethyl* alcohol.
0.0 (= Ethyl acetate).	8.8	8.8	8.8	8.8	8.8	26.32
5.0.....	—	13.83	14.12	—	11.97	—
10.0.....	19.39	16.05	16.92	12.34	13.00	29.32
20.0.....	23.37	18.55	20.00	13.16	14.32	31.16
30.0.....	25.85	19.66	21.75	—	14.75	32.44
40.0.....	27.81	20.08	22.79	12.82	14.71	33.26
50.0.....	29.38	20.07	23.30	11.99	13.98	33.63
60.0.....	30.50	19.67	23.39	10.54	13.09	33.61
70.0.....	31.61	18.78	22.73	—	11.66	33.20
80.0.....	32.56	17.53	21.92	6.70	9.85	32.56
90.0.....	33.44	15.82	20.96	4.35	7.87	31.56
95.0.....	—	14.80	21.31	—	6.97	31.10
100.0.....	34.33	12.87	20.60	2.19	4.27	29.80

* A different sample of *n* Butyl alcohol of $d_{23}^4 = 0.8065$ and b. pt. 112°-118°.

** The solid phase in this case was NaClO₄·H₂O instead of the anhydrous salt.

SODIUM Di CHROMATE Na₂Cr₂O₇·2H₂O.

SOLUBILITY OF SODIUM DICHROMATE IN WATER.

The results of Mylius and Funk, 1900; Gerassimow, 1930 and Rakowski and Nikitina, 1931 were plotted and the following values taken from the average curve.

t°	Gms. Na ₂ Cr ₂ O ₇ per 100 gms. sat. sol.	Solid Phase	t°	Gms. Na ₂ Cr ₂ O ₇ per 100 gms. sat. sol.	Solid Phase
0	62.0	Na ₂ Cr ₂ O ₇ ·2H ₂ O	60	72.9	Na ₂ Cr ₂ O ₇ ·2H ₂ O
15	63.9	"	80	79.0	"
25	65.5	"	82.5	79.9	" + Na ₂ Cr ₂ O ₇
40	68.3	"	90	80.2	Na ₂ Cr ₂ O ₇
50	70.5	"	100	80.6	"

SOLUBILITY IN WATER.

(Mylius and Funk, 1900; see also Salkowski, 1901.)

Sodium Monochromate.				Sodium Dichromate.			
t°.	Gms. Na ₂ CrO ₄ per 100 Gms. Solution.	Mols. Na ₂ CrO ₄ per 100 Mols. H ₂ O.	Solid Phase.	t°.	Gms. Na ₂ Cr ₂ O ₇ per 100 Gms. Solution.	Mols. Na ₂ Cr ₂ O ₇ per 100 Mols. H ₂ O.	Solid Phase.
0	24.07	3.52	Na ₂ CrO ₄ ·10H ₂ O	0	61.98	11.2	Na ₂ Cr ₂ O ₇ ·2H ₂ O
10	33.41	5.55	"	17	63.82	12.1	"
18*	40.10	7.43	"	18†	63.92	12.16	"
18.5	41.65	7.94	"	34.5	67.36	14.2	"
19.5	44.78	9.01	"	52	71.76	17.4	"
21	47.40	10.00	"	72	76.9	22.8	"
25.6	46.08	9.52	Na ₂ CrO ₄ ·4H ₂ O	81	79.8	27.1	"
31.5	47.05	9.90	"	93	81.19	29.6	Na ₂ Cr ₂ O ₇
36	47.98	10.2	"	98	81.25	29.8	"
40	48.97	10.6	"				
45	50.20	11.6	"				
49.5	50.93	11.5	"				
54.5	52.28	12.2	"				
59.5	53.39	12.7	"				
65	55.23	13.7	Na ₂ CrO ₄	0	80.03	19.9	Na ₂ Cr ₂ O ₇ ·H ₂ O.
70	55.15	13.6	"	15†	80.44	20.4	"
80	55.53	13.8	"	18	80.60	20.56	"
100	55.74	14.0	"	55	82.68	23.7	"
				99	85.78	29.9	"

* Sp. Gr. of sat. sol. at 18° = 1.432.

† Sp. Gr. of sat. sol. at 18° = 2.059

‡ Sp. Gr. of sat. solution at 18° = 1.745.

Sodium Tetrachromate.				Tetrasodium Chromate.			
t°.	Gms. Na ₂ Cr ₄ O ₁₃ per 100 Gms. Solution.	Mols. Na ₂ Cr ₄ O ₁₃ per 100 Mols. H ₂ O.	Solid Phase.	t°.	Gms. Na ₄ CrO ₅ per 100 Gms. Solution.	Mols. Na ₄ CrO ₅ per 100 Mols. H ₂ O.	Solid Phase.
0	72.96	10.5	Na ₂ Cr ₄ O ₁₃ ·4H ₂ O	0	33.87	4.11	Na ₄ CrO ₅ ·13HO ₂
16	74.19	11.2	"	10	35.58	4.42	"
18*	74.60	11.27	"	18†	37.50	4.81	"
22	76.01	12.3	"	27.7	40.09	5.38	"
				37	45.13	6.62	"

* Sp. Gr. of sat. solution at 18° = 1.926.

† Sp. Gr. of sat. solution at 18° = 1.446.

A new hydrate of sodium chromate, Na₂CrO₄·6H₂O, was found by Salkowski, (1901) and the following data for its range of existence were determined.

t°.	Gms. Na ₂ CrO ₄ per 100 Gms. Solution.	Mols. Na ₂ CrO ₄ per 100 Mols. H ₂ O.	Solid Phase.	t°.	Gms. Na ₂ CrO ₄ per 100 Gms. Sol.	Mols. Na ₂ CrO ₄ per 100 Mols. H ₂ O.	Solid Phase.
17.7	43.65	8.62	Na ₂ CrO ₄ ·10H ₂ O	25.9	46.3*	9.57	Na ₂ CrO ₄ ·6H ₂ O
19.2	44.12	8.77	"				+Na ₂ CrO ₄ ·4H ₂ O
19.525	44.2	...	" + Na ₂ CrO ₄ ·6H ₂ O	28.9	46.47	9.64	Na ₂ CrO ₄ ·4H ₂ O
21.2	44.64	8.96	Na ₂ CrO ₄ ·6H ₂ O	29.7	46.54	9.67	"
24.7	45.75	9.37	"	31.2	47.08	9.88	"

* This determination by Richards and Kelley (1911).

SOLUBILITY OF SODIUM CHROMATES IN WATER AT 30°.

(Schreinemakers, 1906.)

Composition in weight per cent:

	Of Solution.		Of Residue.		Solid Phase.
	%CrO ₃ .	%Na ₂ O.	%CrO ₃ .	%Na ₂ O.	
	0	± 42	...	...	NaOH.H ₂ O
	2.00	41.44	5.83	42.64	NaOH.H ₂ O + Na ₂ CrO ₄
	2.04	40.89	...	...	Na ₂ CrO ₄
	4.23	35.51	27.52	36.57	"
	6.64	32.34	27.72	34.60	"
	15.19	27.06	37.07	32.20	"
	10.22	29.39	15.48	28.41	Na ₂ CrO ₄ + Na ₄ CrO ₅ .13H ₂ O
	8.93	28.49	18.09	26.89	Na ₄ CrO ₅ .13H ₂ O
	8.62	26.91	...	...	"
	13.12	23.91	18.57	25.92	"
	18.44	22.86	...	...	"
	19.26	22.98	21.54	25.31	Na ₄ CrO ₅ .13H ₂ O + Na ₂ CrO ₄ .4H ₂ O
	17.84	24.21	26.24	24.98	Na ₂ CrO ₄ .4H ₂ O
	28.82	17.88	31.97	23.47	"
	38.93	16.30	40.70	20.83	"
	48.70	16.49	47.49	19.75	Na ₂ CrO ₄ .4H ₂ O + Na ₂ Cr ₂ O ₇ .2H ₂ O
	50.68	15.72	...	...	Na ₂ Cr ₂ O ₇ .2H ₂ O
	58.08	13.89	62.76	17.38	"
	66.13	13.70	69.48	16.06	Na ₂ Cr ₂ O ₇ .2H ₂ O + Na ₂ Cr ₃ O ₁₀ .H ₂ O
	65.98	14.15	69.46	15.15	Na ₂ Cr ₃ O ₁₀ .H ₂ O
	68.46	10.95	73.88	13.38	Na ₂ Cr ₃ O ₁₀ .H ₂ O + Na ₂ Cr ₄ O ₁₈ .4H ₂ O
	66.88	9.85	71.27	10.67	Na ₂ Cr ₃ O ₁₈ .4H ₂ O
	70.06	11.85	83.95	9.57	" (?)
	69.04	11.04	81.80	6.43	CrO ₃
	67.84	9.81	82.85	5.42	"
	64.48	4.51	79.49	2.71	"
	62.28	0.0	...	...	"

100 gms. of a saturated aqueous solution contain at 30°:

46.627 gms. Na₂CrO₄, or 100 gms. H₂O dissolve 87.36 gms. Na₂CrO₄.66.4 gms. Na₂Cr₂O₇, or 100 gms. H₂O dissolve 197.6 gms. Na₂Cr₂O₇.100 gms. absolute methyl alcohol dissolve 0.345 gms. Na₂CrO₄ at 25°.

(de Bruyn, 1892.)

Data for equilibrium in the system sodium chromate, sodium sulfate and water at 15° and at 25° are given by Takenchi (1915). The mixtures were rotated at constant temperature until attainment of equilibrium and both the saturated solutions and the undissolved residues were analyzed. Very extensive tables of results are given. The decahydrates of sodium and chromium are isomorphous and the results show that these two salts are mutually miscible in all proportions at 15°. At 25° the solubility curve consists of three branches. The solutions of the first branch are in equilibrium with decahydrated mixed crystals, those of the second branch with anhydrous sulfate and those of the third with both anhydrous sodium sulfate and hexahydrated sodium chromate.

SODIUM CHROMATE Na_2CrO_4 .EQUILIBRIUM IN THE SYSTEM SODIUM CHROMATE, SODIUM SULFATE AND WATER.
(Osaka and Yoshida, 1922.)

This is a continuation of the work of Takenchi, 1925 (see remarks at bottom of the preceding page). Data are now given for the isotherms at 28° , 31° and 33° . The results are, however, expressed in accordance with the formula $100\ m\ \text{H}_2\text{O}$, $x\ \text{Na}_2\text{CrO}_4$, $(100 - x)\ \text{Na}_2\text{SO}_4$, and the tables show only numerical values corresponding to x and m .

Results for the system $\text{Na}_2\text{Cr}_2\text{O}_7 + \text{Na}_2\text{SO}_4 + \text{H}_2\text{O}$ at 0° , 15° , 25° , 40° , 80° and 98° , and for $\text{Na}_2\text{Cr}_2\text{O}_7 + \text{NaHSO}_4 + \text{H}_2\text{O}$ at 20° are given by Rakowski and Nikitina, 1931.

Results for the systems $\text{Na}_2\text{Cr}_2\text{O}_7 + \text{NH}_4\text{Cl} + \text{H}_2\text{O}$ and $\text{Na}_2\text{Cr}_2\text{O}_7 + (\text{NH}_4)_2\text{Cr}_2\text{O}_7 + \text{H}_2\text{O}$ at 0° , 20° , 50° and 75° , are given by Gerassimow, 1930.

SOLUBILITY OF SODIUM DICHROMATE IN ALCOHOL AT 19.4° .

(Reinitzer, 1913.)

An excess of $\text{Na}_2\text{Cr}_2\text{O}_7 \cdot 2\text{H}_2\text{O}$ was shaken with absolute alcohol for 10 minutes and the mixture filtered. The filtrate contained 5.132 gms. $\text{Na}_2\text{Cr}_2\text{O}_7 \cdot 2\text{H}_2\text{O}$ per 100 cc. and its $d_{19.4}$ was 0.8374. The solution decomposed within a few minutes with production of a brown precipitate and evolution of an aldehyde odor. The results are, therefore, only approximately correct.

CrO

SOLUBILITY OF SODIUM CHROMATE IN MIXTURES OF BENZENE AND ACETIC ACID.

(Anders, 1933.)

t°	Percent CH_3COOH in solvent	Gms. Na_2CrO_4 per 100 gms. sat. sol.	t°	Percent CH_3COOH in solvent	Gms. Na_2CrO_4 per 100 gms. sat. sol.
0	13.627	0.054	15	53.186	7.354
"	27.599	0.395	28	11.489	0.138
"	49.773	3.728	"	28.154	1.282
15	11.649	0.074	"	52.378	8.750
"	29.264	0.863			

The authors also give data for the lowering of the eutectic point of $\text{CH}_3\text{COOH} + \text{C}_6\text{H}_6$ by additions of Na_2CrO_4 , I, S, and AgClO_4 .

SODIUM FLUORIDE NaF

FREEZING-POINTS OF AQUEOUS SOLUTIONS OF SODIUM FLUORIDE.

(Matheson and Maass, 1929.)

t°	Gms. NaF per 100 gms. sat. sol.	Solid Phase
-1.1	0.6	Ice
-1.9	1.03	"
-2.9 Eutectic	1.4	" + NaF

F

SOLUBILITY OF SODIUM FLUORIDE IN WATER.

The results of Jehn and Huddleston, 1924; Carter, 1928; Foote and Schairer, 1930; Nowasselow, 1934; Nagarski and Nowasselow, 1935 and Payne, 1937, fall quite irregularly when plotted, and the average curve from which the following values were taken, can be only approximately correct.

t°	d. of sat. sol.	Gms. NaF per 100 gms. sat. sol.	t°	Gms. NaF per 100 gms. sat. sol.
0	—	3.53	40	4.21
20	—	3.90	50	4.35
25	1.0384	3.98	60	4.47
30	—	4.05	80	4.66
35	1.0354	4.13	100	4.83

SODIUM FLUORIDE NaF.

SOLUBILITY OF SODIUM FLUORIDE IN AQUEOUS SOLUTIONS OF HYDROFLUORIC ACID
AT 20°.

(Jehn and Huddleston, 1924.)

Saturation was obtained by constant stirring in a thermostat for 14 and 30 days. Paraffine bottles were employed.

Gms. per 100 gms. H ₂ O.		Solid Phase.	Gms. per 100 gms. H ₂ O.		Solid Phase.
NaF.	HF.		NaF.	HF.	
3.96	0.0	NaF	2.46	1.16	NaF.HF
4.14	0.081	»	2.49	1.20	»
4.19	0.104	»	2.20	1.55	»
4.23	0.135	»	2.04	2.22	»
4.51	0.420	»	2.01	2.70	»
4.56	0.484	»+NaF.HF	1.88	4.17	»
3.45	0.660	NaF.HF	1.83	8.68	»
2.99	0.831	»	1.79	10.28	»

SOLUBILITY OF SODIUM FLUORIDE IN AQUEOUS SOLUTIONS OF
HYDROGEN PEROXIDE AT 25°.

(Akerlof and Turck, 1935.)

Wt. Percent H ₂ O ₂ in Solvent	Gms. Mols. NaF per 1000 gms. solvent
0.0	0.9989
15.72	1.216
31.43	1.457

FREEZING-POINTS OF HYDROGEN PEROXIDE SOLUTIONS OF SODIUM FLUORIDE.

(Matheson and Mass, 1929.)

t°	Gm. Mols. NaF per 100 gm. mols. H ₂ O + NaF	Solid Phase	t°	Gm. Mols. NaF per 100 gm. mols. H ₂ O + NaF	Solid Phase
- 5.2	3.8	H ₂ O ₂	-12.1	9.8	H ₂ O ₂
- 9.1	7.4	»	-13.9	11.1	»
-10.6	8.0	»	-15.2 Eutec.	12.3	» + NaF

SOLUBILITY OF MIXTURES OF SODIUM FLUORIDE AND SODIUM BERYLLIUM
FLUORIDE IN WATER.
(Nowasselow, 1934.)

t°	Gms. per 100 gms. sat. sol.		Solid Phase	t°	Gms. per 100 gms. sat. sol.		Solid Phase
	NaF	Na ₂ BeF ₄			NaF	Na ₂ BeF ₄	
0	3.81	0.22	NaF + Na ₂ BeF ₄	60	3.85	0.47	NaF + Na ₂ BeF ₄
20	3.84	0.26	"	80	3.85	0.57	"
40	3.76	0.45	"	94	3.85	0.80	"

SOLUBILITY OF SODIUM FLUORIDE IN AQUEOUS SOLUTIONS OF SODIUM HYDROXIDE.
(Nagorski and Nowosselow, 1935.)

Wt. Percent NaOH in Solvent	Gms. NaF per 100 gms. sat. solution at:				
	0°	20°	40°	80°	94°
0.0 (= H ₂ O)	3.99	4.10	4.47	4.48	4.73
0.81	3.49	3.40	3.51	3.56	3.47
1.67	—	2.89	—	—	—
2.30	2.65	2.70	2.81	2.82	3.03
2.70	2.37	2.45	2.70	2.84	2.73
5.66	—	1.68	—	—	—
7.90	—	1.25	—	—	—
18.40	—	0.38	—	—	—

Phase studies of the system Sodium Fluoride, Sodium Phosphate and Water at 25° and at 40° are given by Mason and Ashcraft, 1939. The results show that the supposed octahedral Na₃PO₄·10H₂O is really the double salt NaF·2Na₃PO₄·19H₂O, in samples of tri sodium phosphate containing as little as 0.1 percent Sodium Fluoride.

F

EQUILIBRIUM IN THE SYSTEM SODIUM FLUORIDE, SODIUM SULFATE
AND WATER.

(Foote and Schairer, 1930.)

t°	Gms. per 100 gms. sat. sol.		Solid Phase	t°	Gms. per 100 gms. sat. sol.		Solid Phase
	Na ₂ SO ₄	NaF			Na ₂ SO ₄	NaF	
-3.0	0.0	3.92	Ice + NaF	25	8.67	2.35	NaF + 1.1
-1.12	4.07	0.0	" + Na.10	"	11.48	1.74	1.1
-3.06	1.68	3.42	" + " + NaF	"	21.34	0.37	" + Na.10
10.	0.0	3.92	NaF	"	21.71	0.0	Na.10
"	3.95	3.20	"	33.26	33.10	trace	" + Na.10 + Na
"	6.39	2.98	" + Na.10	35	0.0	4.02	NaF
"	8.34	0.0	Na.10	"	4.34	3.18	"
15	0.0	3.93	NaF	"	8.62	2.50	" + 1.1
"	9.50	2.50	" + Na.10	"	9.58	2.09	1.1
"	11.70	0.0	Na.10	"	11.60	1.57	"
17.47	12.58	1.91	1.1 + Na.10 + NaF	"	18.11	0.62	"
25	0.0	3.98	NaF	"	32.80	trace	" + Ni
"	4.48	3.13	"	"	32.96	0.0	Na

Na.10 = Na₂SO₄·10H₂O; Na = Na₂SO₄; 1.1 = NaF·Na₂SO₄.

Results for the quarternary system NaF + NaCl + Na₂SO₄ + H₂O at 25° and at 35° are also given.

100 gms. Liquid Ammonia (NH₃) dissolve 0.35 gm. NaF at 25°. (Hunt, 1932.)
100 gms. Liquid Sulfur Dioxide (SO₂) dissolve 0.029 gm. NaF at 0°.

(Jander and Ruppolt, 1937.)

**Na NATRIUM
SODIUM FLUORIDE**

1260

**SOLUBILITY OF SODIUM FLUORIDE IN SEVERAL ALCOHOLS, EACH
DETERMINED SEPARATELY.**

(Germuth, 1931.)

t°	Gms. NaF per 100 gms. sat. solution in:		
	Methyl Alcohol CH ₃ OH	Ethyl Alcohol C ₂ H ₅ OH	n Butyl Alcohol CH ₃ (CH ₂) ₃ CH ₂ OH
20	0.413	0.095	0.0030
30	0.440	0.108	0.0041
40	0.458	0.119	0.0043
50	0.476	0.158	0.0049
55	0.484	0.179	0.0054

SOLUBILITY OF SODIUM FLUORIDE IN ACETONE.

(Lannung, 1932.)

t°	d. of sat. sol.	Gms. NaF per 1000 per Acetone
18	0.792	0.000024
37	0.770	0.000027

Fusion-point data are given for

F	NaF + FeF ₃	(Puschin and Baskov, 1913.)
	" + ZnF ₂	" "
	" + NaI	(Ruff and Plato, 1903.)
	" + NaOH	(Scarpa, 1915.)
	" + Na ₂ SO ₄	(Wolters, 1910.)
	" + Na ₂ SiO ₃	(Booth and Starrs, 1931.)
	" + Na ₂ Si ₄ O ₉	(Booth, Starrs and Bahnsen, 1933.)

SODIUM Aluminum FLUORIDE (Cryolite) Na₃AlF₆.

100 cc sat. solution of Sodium Aluminum Fluoride in Water contain 0.061 gms. Na₃AlF₆ at 25°. (Carter, 1928.)

SODIUM Beryllium FLUORIDE Na₂BeF₄.

SOLUBILITY OF SODIUM BERYLLIUM FLUORIDE IN WATER.

(Nowasselowa, 1934.)

t°	Gms. Na ₂ BeF ₄ per 100 gms. sat. sol.	t°	Gms. Na ₂ BeF ₄ per 100 gms. sat. sol.
0	1.31	60	2.19
20	1.41	80	2.55
40	1.88	94	2.70

SODIUM (Double) PHOSPHATE, FLUORIDE Na₃PO₄.NaF.12H₂O.

100 gms. water dissolve 12 gms. of the double sodium salt at 25°, and 57.5 gms. at 70°. Sp. Gr. of solution at 25° = 1.0329; at 70° = 1.1091. (Briegleb, 1856.)

SODIUM Silico FLUORIDE NaSiF_6 .

NATRIUM N

SOLUBILITY OF SODIUM SILICO FLUORIDE IN WATER.

(Carter, 1930.)

t°	Gms. NaSiF_6 per 100 cc sat. sol.	t°	Gms. NaSiF_6 per 100 cc sat. sol.	t°	Gms. NaSiF_6 per 100 cc sat. sol.
0°	0.435	25	0.762	55	1.328
16	0.637	35	0.940	78	1.822
20(d=1.0054)	0.737(1)	45	1.120	100	2.45 (2)

(1) Worthington and Haring, 1931; (2) Stolba, 1872.

SODIUM Silico FLUORIDE

SOLUBILITY OF SODIUM SILICO FLUORIDE IN AQUEOUS
SOLUTIONS OF SODIUM SULFATE.

(Rees and Hudleston, 1931.)

Results at 17°

Results at 20°

Gm. Mols. Na_2SO_4 per 1000 gms. solvent	Gm. Mols. Na_2SiF_6 per 1000 gms. sat. sol.	Gm. Mols. Na_2SO_4 per 1000 gms. solvent	Gm. Mols. Na_2SiF_6 per 1000 gms. sat. sol.
0.000	0.0329	0.000	0.0363
0.050	0.0143	0.0050	0.0336
0.125	0.0068	0.0100	0.0309
0.250	0.0042	0.0150	0.0284
0.375	0.0034	0.0250	0.0201
0.500	0.0029	0.0500	0.0168

SODIUM Titano FLUORIDE Na_2TiF_6 .SOLUBILITY OF SODIUM TITANO FLUORIDE IN WATER
AND IN ETHYL ALCOHOL.

(Ginsberg, 1932.)

t°	Solvent	Gms. Na_2TiF_6 per 100 cc sat. sol.
20-22	Water	6.5
20-22	98% $\text{C}_2\text{H}_5\text{OH}$	0.0031

SODIUM GERMANATE $\text{Na}_2\text{GeO}_3 \cdot 7\text{H}_2\text{O}$.

SOLUBILITY OF SODIUM GERMANATE IN WATER.

(Pugh, 1932.)

t°	Gms. Na_2GeO_3 per 100 gms. H_2O	Solid Phase	t°	Gms. Na_2GeO_3 per 100 gms. H_2O	Solid Phase
- 0.7	2.38	Ice	30	28.65	$\text{Na}_2\text{GeO}_3 \cdot 7\text{H}_2\text{O}$
- 2.0	8.04	"	35	32.6	"
- 3.0	12.40	"	45	42.0	"
- 3.2 Eutec.	13.1	" + $\text{Na}_2\text{GeO}_3 \cdot 7\text{H}_2\text{O}$	52.5	52.7	"
0	14.5	$\text{Na}_2\text{GeO}_3 \cdot 7\text{H}_2\text{O}$	63.5	72.0	"
+15.2	21.4	"	70.5	85.5	"
20.2	23.7	"	75.5	99.6	"
25.0	25.9	"	83.5	132.0	"

Geo

SODIUM IODIDE $\text{NaI} \cdot 2\text{H}_2\text{O}$.

SOLUBILITY IN WATER.

(de Coppet, 1883; see also Etard, 1884; and Kremers, 1856a.)

t°.	Grams NaI per 100 Gms.		Solid Phase.	t°.	Grams NaI per 100 Gms.		Solid Phase.
	Water.	Solution.			Water.	Solution.	
20	148.0	59.7	$\text{NaI} \cdot 2\text{H}_2\text{O}$	60	256.8	72.0	$\text{NaI} \cdot 2\text{H}_2\text{O}$
0	158.7	61.4	"	65	278.4	73.6	"
10	168.6	62.8	"	67	293	74.6	NaI
20	178.7	64.1	"	70	294	74.6	"
25	184.2	64.8	"	80	296	74.7	"
30	190.3	65.6	"	100	302	75.1	"
40	205.0	67.2	"	120	310	75.6	"
50	227.8	69.5	"	140	321	76.3	"

The eutectic mixture of Ice + $\text{NaI} \cdot 5\text{H}_2\text{O}$ is at -31.5° and contains about 39 per cent NaI. (Meyerhoffer, 1904.)

I The tr. pt. for $\text{NaI} \cdot 5\text{H}_2\text{O}$ + $\text{NaI} \cdot 2\text{H}_2\text{O}$ is at -13.5 and the saturated solution contains 60.2 gms. NaI per 100 gms. (Panfiloff, 1893a.)

The tr. pt. for $\text{NaI} \cdot 2\text{H}_2\text{O}$ + NaI is at 64.3° and the saturated solution contains 74.4 gms. NaI per 100 gms. (Panfiloff, 1893.)

100 gms. H_2O dissolve 172.4 gms. NaI at 15° and the d_{15} of the sol. is 1.8937. (Greenish, 1900.)

100 gms. sat. solution in H_2O contain 65.5 gms. NaI at 30° . (Cocheret, 1911.)

More recent very careful determinations of the Solubility of Sodium Iodide in Water by Scott and Durham, 1930; Ricci and Yanick, 1936; Hill, Willson and Bishop, 1933; and Ricci, 1934; 1936, give a very smooth curve from which the following values were read.

t°	d. of		Solid Phase	t°	d. of		Solid Phase
	sat. sol.	100 gms. sat. sol.			sat. sol.	100 gms. sat. sol.	
0	1.8612	61.54	$\text{NaI} \cdot 2\text{H}_2\text{O}$	63.13	2.1068	72.95	$\text{NaI} \cdot 2\text{H}_2\text{O}$
15	1.881	63.33	"	68.1	2.1550	74.85	" + NaI
25	1.919	64.76	"	75.4	2.1544	74.82	NaI
35	1.951	66.35	"	92.23	2.1425	75.05	"
50	2.017	69.42	"	100.0	—	75.14	"

EQUILIBRIUM IN THE SYSTEM SODIUM IODIDE, SODIUM IODATE AND WATER.
(Ricci, 1934.)

d. of sat. sol.	Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase
	NaI	NaIO ₃			NaI		NaIO_{3}
Results at 20°				Results at 40°		
1.318	30.43	1.58	DS20	0.0	11.70	NaIO ₃ ·H ₂ O
1.409	38.26	0.513	"	40.84	3.02	NaIO ₃ + DS15
1.686	54.96	0.062	"	48.20	0.95	DS15
1.811	61.36	0.042	"	56.16	0.36	"
				62.52	0.30	"
				65.39	0.32	" + DS10
				66.40	0.31	DS10
1.075	0.0	8.569	NaIO ₃ ·H ₂ O	66.89	0.30	"
—	31.57	2.42	" + DS20	67.10	0.30	" + NaI·2H ₂ O
1.355	33.06	1.96	DS20	67.35	0.0	NaI·2H ₂ O
—	34.29	1.62	"			
1.391	36.56	1.18	"	Results at 55°		
1.443	40.42	0.704	"			
1.494	43.91	0.455	" + DS15	60.97	0.82	DS10
—	46.06	0.314	DS15	63.59	0.67	"
1.605	54.42	0.102	"	66.78	0.60	"
1.884	63.71	0.069	"	68.03	0.61	"
—	64.70	0.075	" + NaI·2H ₂ O	69.11	0.59	"
1.904	64.71	0.0	NaI·2H ₂ O			

DS₂₀ = 3NaI·2NaIO₃·20H₂O; DS₁₅ = 3NaI·2NaIO₃·15H₂O; DS₁₀ = 3NaI·2NaIO₃·10H₂O.

Additional results for this system at 8°, 25° and 40° are given by Hill, Willson and Bishop, 1933, but these authors failed to determine the true nature of the solid phases. They reported the presence of solid solutions (mixed crystals) instead of the double salt here shown to exist

EQUILIBRIUM IN THE SYSTEM SODIUM IODIDE, SODIUM
NITRATE AND WATER AT 25°.
(Ricci, Budish and Borodulia, 1937.)

Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase
NaNO ₃	NaI		NaNO ₃	NaI	
0.0	64.71	NaI·2H ₂ O	6.77	57.64	NaNO ₃
2.57	63.12	"	8.73	52.70	"
3.93	62.06	"	10.64	49.22	"
5.48	61.13	" + NaNO ₃	14.38	42.48	"
5.63	60.88	NaNO ₃	22.57	30.49	"
			47.87	0.0	"

Na NARIUM SODIUM IODIDE

1264

EQUILIBRIUM IN THE SYSTEM SODIUM IODIDE, SODIUM SULFATE AND WATER. (Ricci, 1936.)

d. of sat. sol.	Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase
	Na_2SO_4	NaI		Na_2SO_4	NaI	
Results at 15°						
1.881	0.0	63.35	NaI.2H ₂ O	7.97	31.21*	Na ₂ SO ₄
1.881	0.03	63.32	" + Na ₂ SO ₄	14.91	21.22*	"
1.875	0.02	62.89	Na ₂ SO ₄	26.65	7.60*	"
1.733	0.15	56.92	"	33.97	0.0*	"
1.613	0.93	50.15	"	7.63	31.77	" + Na ₂ SO ₄ .10H ₂ O
1.542	2.21	44.83	" + Na ₂ SO ₄ .10H ₂ O	7.94	30.05	Na ₂ SO ₄ .10H ₂ O
1.532	2.13	44.07	Na ₂ SO ₄ .10H ₂ O	8.70	26.84	"
1.490	2.10	41.78	"	9.37	24.81	"
1.460	2.15	39.67	"	10.81	20.30	"
1.367	2.51	33.16	"	14.87	11.50	"
1.106	11.60	0.0	"	17.54	6.77	"
				21.78	0.0	"
Results at 25° (con.)						

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* Metastable

EQUILIBRIUM IN THE SYSTEM SODIUM IODIDE, ANTIMONY IODIDE AND WATER. (Francois and Delwaulle, 1936.)

Numerical results are not given but only a diagram from which the following approximate values were read

Results at 15°		Results at 35°		Results at 60°		Solid Phase at each temperature
Gms. per 100 gms. H_2O	SbI_3	Gms. per 100 gms. H_2O	SbI_3	Gms. per 100 gms. H_2O	SbI_3	
0.0	173	0.0	197	0.0	256	$\text{NaI} \cdot 2\text{H}_2\text{O}$
—	—	15.0	200	50	260	"
10	175	25	205	85	275	" + 2.1.8
12	150	35	165	80	240	2.1.8
30	125	55	130	90	170	"
50	100	80	110	150	140	"
65	90	100	105	175	140	" + 1.1.6
60	75	100	90	185	120	1.1.6
—	—	—	—	200	110	" + SbI_3
—	—	—	—	130	70	SbI_3

2.1.8 = $2\text{NaI} \cdot \text{SbI}_3 \cdot 8\text{H}_2\text{O}$; 1.1.6 = $\text{NaI} \cdot \text{SbI}_3 \cdot 6\text{H}_2\text{O}$.

SOLUBILITY OF SODIUM IODIDE IN AQUEOUS ETHYL ALCOHOL AT 30°.

(Cocheret, 1911.)

Gms. per 100	Gms. Sat. Sol.	Solid Phase.	Gms. per 100	Gms. Sat. Sol.	Solid Phase.
NaI.	C ₂ H ₅ OH.		NaI.	C ₂ H ₅ OH.	
65.52	0	NaI.2H ₂ O	38.5	53.2	NaI.2H ₂ O
64	3.42	"	37.49	55.37	" + NaI
54.2	18.5	"	35.65	59.24	NaI
48.8	28.5	"	33.24	61.78	"
42.35	41.7	"	30.90	68.70	"

Data are also given for the solubility of mixtures of NaI + Na₂CO₃ in aqueous ethyl alcohol at 30°.

EQUILIBRIUM IN THE SYSTEM SODIUM IODIDE, ACETONE AND WATER AT 25°.

(Macy and Thomas, 1926.)

The materials were carefully purified. Saturation was secured by constant stirring in a thermostat.

d of sat. sol.	Gms. per 100 gms. sat. sol.		Solid Phase.	d of sat. sol.	Gms. per 100 gms. sat. sol.		Solid Phase.
	NaI.	CH ₃ COCH ₃ .			NaI.	CH ₃ COCH ₃ .	
1.927	67.0	0.0	NaI.2H ₂ O	1.240	40.5	53.4	NaI
1.753	60.2	8.2	"	1.192	37.7	58.0	"
1.565	54.3	19.4	"	1.144	34.7	62.9	"
1.450	49.9	30.1	"	1.067	29.4	70.6	" (unstable)
1.358	46.3	40.3	"	1.062	25.8	71.5	NaI.3(CH ₃ COCH ₃)
1.320	44.5	46.1	" + NaI				

SOLUBILITY OF SODIUM IODIDE IN PURE METHYL ALCOHOL.

(Lloyd, Brown, Glynwyn, Bonnell and Jones, 1928.)

t°	Gms. NaI per 100 gms. CH ₃ OH	Solid Phase	t°	Gms. NaI per 100 gms. CH ₃ OH	Solid Phase
10	65.0	NaI.3CH ₃ OH	28	81.8	NaI.3CH ₃ OH
20	72.9	"	30	81.4	NaI
25	78.0	"	40	80.7	"
27	81.3	"	50	80.1	"
			60	79.4	"

SOLUBILITY OF SODIUM IODIDE IN ETHYL ALCOHOL AT 25°.

(King and Partington, 1926.)

The authors used the greatest possible care in the purification of the alcohol and sodium iodide. They used a special apparatus designed to prevent the entrance of moisture and kept the solution in contact with dry hydrogen. The mixture was constantly stirred for 16 hours. The mean of 10 determinations gave 42.57 gms. NaI per 100 gms C₂ H₅ OH and the d_{25}^{25} of the sat. sol. was 1.037.

SOLUBILITY OF SODIUM IODIDE IN ABSOLUTE ETHYL ALCOHOL AT TEMPERATURES UP TO THE CRITICAL POINT.

(Tyrer, 1910a.)

t°.	Gms. NaI per 100 Gms. C ₂ H ₅ OH	t°.	Gms. NaI per 100 Gms. C ₂ H ₅ OH.	t°.	Gms. NaI per 100 Gms. C ₂ H ₅ OH.
10	43.77	120	45.2	240	32.7
30	44.25	160	45	250	26.2
50	44.50	180	44.3	255	21
80	45	200	42.3	260	10.8
100	45.1	220	38.5	261.5*	8.6
		230	36.2		

* crit. t. of solution.

The mixtures were placed in sealed glass tubes which were heated in a specially constructed, electrically heated air bath. The temperature at which the last trace of salt just dissolved was determined in each case. The experiments were made with very great care. Results are also given for the solubility of sodium iodide in the vapor of ethyl alcohol above the critical point.

SOLUBILITY OF SODIUM IODIDE IN ALCOHOLS AT 25°.

(Turner and Bissett, 1913.)

100 gms.	Methyl alcohol,	CH ₃ OH	dissolve	90.35 gms.	NaI.
"	Ethyl	"	C ₂ H ₅ OH	"	46.02 "
"	Propyl	"	C ₃ H ₇ OH	"	28.22 "
"	Amyl	"	C ₅ H ₁₁ OH	"	16.30 "

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SOLUBILITY OF SODIUM IODIDE IN MIXTURES OF ALCOHOLS AT 25°.

(Herz and Kuhn, 1908.)

In CH ₃ OH + C ₂ H ₅ OH.			In CH ₃ OH + C ₃ H ₇ OH.			In C ₂ H ₅ OH + C ₃ H ₇ OH.		
Per cent CH ₃ OH in Mixture.	d ₂₅ ²⁵ of Sat. Sol.	Gms. NaI per 100 cc. Sat. Sol.	Per cent C ₃ H ₇ OH in Mixture.	d ₂₅ ²⁵ of Sat. Sol.	Gms. NaI per 100 cc. Sat. Sol.	Per cent C ₃ H ₇ OH in Mixture.	d ₂₅ ²⁵ of Sat. Sol.	Gms. NaI per 100 cc. Sat. Sol.
0	1.0806	35.15	0	1.3250	63.22	0	1.0806	35.15
4.37	1.1029	37.68	11.11	1.2853	58.45	8.1	1.0732	34.60
10.4	1.1123	38.71	23.8	1.2528	54.64	17.85	1.0720	34.05
41.02	1.1742	45.98	65.2	1.1387	40.71	56.6	1.0276	28.41
80.60	1.2741	57.44	91.8	1.0420	29.14	88.6	1.0130	26.13
84.77	1.2886	58.92	93.75	1.0178	26.49	91.2	1.0104	25.88
91.25	1.3056	61.10	100	0.9968	24.11	95.2	1.0020	24.74
100	1.3250	63.22				100	0.9968	24.11

SOLUBILITY OF SODIUM IODIDE IN SEVERAL SOLVENTS.

(At 22.5°, de Bruyn, 1892; at ord. temp. Rohland, 1898; Walden, 1906.)

Solvent.	t°.	Gms. NaI per 100 Gms. Solvent.	Solvent.	Gms. NaI per 100 cc. Sat. Solution.	
				at 0°.	at 25°.
Absolute Ethyl Alcohol	22.5	43.1	Acetonitrile	22.09	18.43
Ethyl Alcohol, d ₁₅ = 0.810	ord. temp.	58.8	Propionitrile	0.09	6.23
Absolute Methyl Alcohol	22.5	77.7	Nitro Methane	0.34	0.48
Methyl Alcohol, d ₁₅ = 0.799	ord. temp.	83.3	Acetone	very soluble	
Propyl Alcohol, d ₁₅ = 0.816	ord. temp.	26.3	Furfural	...	25.10

SOLUBILITY OF SODIUM IODIDE IN SEVERAL SOLVENTS AT 25°.
(Larson and Hunt, 1939.)

Solvent	Formula	d. of sat. sol.	Gms. NaI per 100 gms. solvent
Methanol	CH_3OH	1.2615	80.53
Ethanol	$\text{C}_2\text{H}_5\text{OH}$	1.0466	43.32
1-Propanol	$\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$	0.9699	27.65
1-Butanol	$\text{CH}_3(\text{CH}_2)_3\text{CH}_2\text{OH}$	0.9397	21.60
2-Propanol (iso)	$\text{CH}_3\text{CHOHCH}_3$	0.9422	26.32
2-Methyl-1-propanol (iso butyl)	$(\text{CH}_3)_2\text{CHCH}_2\text{OH}$	0.9085	17.68
1-Pentanol	$\text{CH}_3(\text{CH}_2)_4\text{CH}_2\text{OH}$	0.9127	16.31
2-Butanol (Sec.)	$\text{CH}_3\text{CH}_2\text{CHOHCH}_3$	0.8068	15.02

SOLUBILITY OF SODIUM IODIDE IN ETHYL ALCOHOL CONTAINING
INCREASING AMOUNTS OF LITHIUM PERCHLORATE AT 25°.
(Hawkins and Partington, 1930.)

d. of sat. sol.	Gms. per 100 gms. $\text{C}_2\text{H}_5\text{OH}$			Solid Phase
	NaI	LiClO_4	Total Solids*	
1.0460	42.85	0.0	42.85	NaI
1.0522	43.15	0.864	43.88	"
1.0554	43.14	1.760	44.81	"
1.0569	43.02	2.33	45.24	"
1.0572	42.79	2.775	45.39	" + NaClO_4 + LiI
1.0553	42.34	2.39	44.73	" " "
1.0558	42.10	1.85	43.58	" " "

* Determined by evaporation.

SOLUBILITY OF SODIUM IODIDE AT 25° IN ETHYL ALCOHOL IN PRESENCE OF:
(King and Partington, 1927.)

Lithium Iodide

Sodium Thiocyanate

d. of sat. sol.	Gms. per 100 gms. $\text{C}_2\text{H}_5\text{OH}$		d. of sat. sol.	Gms. per 100 gms. $\text{C}_2\text{H}_5\text{OH}$	
	NaI	LiI		NaI	NaSCN
1.0460	42.85	0.0	1.0460	42.85	0.0
1.0471	34.71	8.08	1.0422	41.81	1.17
1.0476	29.56	13.31	1.0360	39.18	3.93
1.0561	15.57	27.75	1.0309	36.70	6.48
1.0975	3.18	46.80	1.0305	36.25	6.91
1.1099	2.56	49.44	1.0299	35.65	7.61
—	0.0	250.8	0.8825	0.0	20.99

SOLUBILITY OF SODIUM IODIDE IN ALCOHOLS.
(Partington, and Winterton, 1934.)

Alcohol	Formula	t°	Gms. NaI per 100 gms. sat. solution
Allyl Alcohol	$\text{CH}_2=\text{CHCH}_2\text{OH}$	25	22.17
Benzyl Alcohol	$\text{C}_6\text{H}_5\text{CH}_2\text{OH}$	25	12.59

SOLUBILITY OF SODIUM IODIDE IN ACETONE.

Results of
Macy and Thomas, 1926.

t°.	d of sat sol.	Gms. NaI per 100 gms. sat. sol.	Solid Phase.
-34.0...	-	3.2	NaI.3(CH ₃ COCH ₃)
-12.3...	0.873	7.4	"
0.0...	0.899	11.6	"
+15.9...	0.984	21.0	"
25.0...	1.062	28.5	"
25.7...	1.070	29.2	" + NaI
25.0...	1.067	29.4	NaI (unstable)
32.2...	1.043	32.2	NaI
40.2...	-	26.8	"
50.0...	-	25.0	"
57.2...	-	23.6	"
59.8...	-	23.0	"

Results of
Wadsworth and Dawson, 1926.

t°.	Gms. NaI per 100 gms. CH ₃ COCH ₃ .	Solid Phase.
-20.0...	5.5	NaI.3(CH ₃ COCH ₃)
-10.0...	7.8	"
0.0...	11.8	"
10.0...	18.2	"
20.0...	30.0	"
25.7...	40.7	" + NaI
30.0...	39.2	NaI
40.0...	35.6	"
50.0...	32.0	"
60.0...	28.6	"
70.0...	25.1	"
80.0...	21.8	"

SOLUBILITY OF SODIUM IODIDE IN ABSOLUTE ACETONE.

(Bell, Rowlands, Bamford, Thomas and Jones, 1931.)

I	t°	Gms. NaI per 100 gms. CH ₃ COCH ₃	Solid Phase	t°	Gms. NaI per 100 gms. CH ₃ COCH ₃	Solid Phase
	0	11.5	NaI.3(CH ₃ COCH ₃)	30	38.9	NaI
	10	18.2	"	35	36.7	"
	15	23.2	"	37	33.1 (1)	"
	18	24.7 (1)	"	40	34.8	"
	20	29.9	"	45	32.9	"
	25	40.1	"	50	30.9	"
				55	29.3	"

(1) Lannung, 1932.

100 gms. pure acetone sat. with CO₂ and NaI contain 23.4 gms. NaI at 16°. A saturated solution of NaI in acetone, through which a stream of CO₂ is passed, yields crystals of NaI.3(CH₃COOCH₃).

SOLUBILITY OF SODIUM IODIDE IN ACETAMIDE.

(Menschutkin, 1908.)

t°.	Gms. per 100 Gms. Sat. Sol.		Solid Phase	t°.	Gms. per 100 Gms. Sat. Sol.		Solid Phase.
	$\text{NaI} \cdot 2\text{CH}_3\text{CONH}_2 = \text{NaI}$.				$\text{NaI} \cdot 2\text{CH}_3\text{CONH}_2 = \text{NaI}$.		
82	m. pt. of pure acetamide		CH_3CONH_2	50	59	33	$\text{NaI} \cdot 2\text{CH}_3\text{CONH}_2$
78	9.5	5.32	"	60	60.5	33.9	"
74	18	10.08	"	70	62.2	34.8	"
70	25.5	14	"	80	64.2	35.9	"
66	31.9	17.86	"	90	66.5	37.2	"
62	37.3	20.9	"	100	69.2	38.7	"
58	41.9	23.44	"	110	72.6	40.6	"
54	46.1	25.8	"	120	78.7	44	"
50	50	28	"	125	84.7	47.4	" + NaI
46	53.7	30.1	"	150	85.1	47.7	NaI
41.5	57.7	32.3	" + $\text{NaI} \cdot 2\text{CH}_3\text{CONH}_2$	175	85.5	47.9	"

100 cc. anhydrous hydrazine dissolve 6.1 gms. NaI at room temp.

(Welsh and Broderson, 1915.)

SOLUBILITY OF SODIUM IODIDE IN METHYL ETHYL KETONE.
(Wadsworth and Dawson, 1926.)

t.	Gms. NaI per 100 gms. CH ₃ CO.C ₂ H ₅ .	Solid Phase.	t°.	Gms. NaI per 100 gms. CH ₃ CO.C ₂ H ₅ .	Solid Phase.
-70.....	7.3	NaI.3(CH ₃ CO.C ₂ H ₅)	+10.....	17.4	NaI
-60.....	10.0	"	20.....	15.0	"
-50.....	14.0	"	30.....	12.7	"
-30.....	28.0	" + NaI	40.....	10.7	"
-20.....	25.0	NaI	50.....	8.9	"
-10.....	22.8	"	60.....	7.4	"
0.....	20.1	"	70.....	6.2	"

SOLUBILITY OF SODIUM IODIDE IN LIQUID AMMONIA.

t°	Gms. NaI per 100 :		Authority
	gms. sat. sol.	cc sat. sol.	
-42.2	—	44.8	(Sherer, 1931.)
-37.8	—	48.8	" "
-35.2	—	51.3	" "
-31.5	—	54.6	" "
0	56.88	—	(Linhard and Stephan, 1933, 1934.)
25	59.40	—	(Hunt, 1932.)

100 gms. Liquid Sulfur Dioxide (SO₂) dissolve 15.0 gms. NaI at 0°
(Jander and Ruppolt, 1937.)

Results for the vapor pressure-temperature relations in the system
NaI + SO₂ are given by Foote and Fleischer, 1931.

Fusion-point data for NaI + NaOH are given by Scarpa, 1915.

SODIUM Mercuric IODIDE

A saturated solution at 24.75°, prepared by adding NaI and HgI₂ in excess to water, contained 4.59% Na, 25% Hg, 58.25% I and 12.2% H₂O, corresponding to 0.20 mol. alkali, 0.12 mol. Hg and 0.45 mol. I.
(Duboin, 1905.)

SODIUM IODATE NaIO₃.H₂O.

SOLUBILITY OF SODIUM IODATE IN WATER.

(Foote and Vance, 1928; Cornec and Spack, 1931; Hill and Donovan, 1931.)

t°	d. of sat. sol.	Gms. NaIO ₃ per 100 gms. sat. sol.	Solid Phase	t°	d. of sat. sol.	Gms. NaIO ₃ per 100 gms. sat. sol.	Solid Phase
- 0.35	—	2.38	Ice+NaIO ₃ .5H ₂ O	40	1.102	11.71	NaIO ₃ .H ₂ O
0	1.024	2.42	NaIO ₃ .5H ₂ O	50	1.119	14.0	"
5	1.028	3.30	"	60	1.142	16.5	"
10	1.041	4.39	"	70	1.164	19.0	"
15	1.052	5.86	"	80	1.190	22.2*	"
19.85	1.070	7.83	" + NaIO ₃ .H ₂ O	73.4	1.172	20.0	" + NaIO ₃
25.0	1.077	8.67	NaIO ₃ .H ₂ O	67.0	—	19.0*	NaIO ₃
25.0	1.075	8.57(1)	"	80	1.180	21.0	"
30	1.085	9.63	"	90	1.192	22.8	"
35	1.093	10.58	"	100	1.204	24.8	"

* Metastable; (1) Ricci, 1934.

EQUILIBRIUM IN THE SYSTEM SODIUM IODATE, IODIC ACID AND WATER AT 30°.

(Meerburg, 1905.)

Gms. per 100	Gms. Sat. Sol.	Solid Phase.	Gms. per 100	Gms. Sat. Sol.	Solid Phase.
HIO ₃ .	NaIO ₃ .		HIO ₃ .	NaIO ₃ .	
0	9.36	NaIO ₃ .1½H ₂ O	11.20	7.54	Na ₂ O.2I ₂ O ₅
1.98	9.52	"	11.82	7.20	" + NaIO ₃ .2HIO ₃
4.86	10.22	"	11.62	5.65	NaIO ₃ .2HIO ₃
5.86	11.04	"	23.23	3.69	"
7.40	11.60	" unstable	32.68	2.91	"
9.73	14.73	" "	46.62	2.67	"
6.70	11.21	" + Na ₂ O.2I ₂ O ₅	55.48	2.12	"
7.80	10.30	Na ₂ O.2I ₂ O ₅	65.47	1.83	"
9.15	9	"	76.19	1.42	" + HIO ₃
9.93	8.71	"	76.70	0	HIO ₃

EQUILIBRIUM IN THE SYSTEM SODIUM IODATE, SODIUM NITRATE AND WATER.

The isotherms at 8°, 25°, and 35° are given by Foote and Vance, 1929(a); those for 5°, 25° and 50° by Hill and Donovan, 1931; and that for 0° and the triple points for various temperatures up to 100° are given by Cornec and Spack, 1931.

d. of	Gms. per 100	Gms. sat. sol.	Solid	d. of	Gms. per 100	Gms. sat. sol.	Solid
sat. sol.	NaNO ₃	NaIO ₃	Phase	sat. sol.	NaNO ₃	NaIO ₃	Phase
Results at 0°				Results at 8° (con.)			
1.357	42.0	0.53	NaNO ₃	—	32.23	2.27	Na.1
1.360	41.8	0.82	" + DS	—	30.93	2.24	" + Na ₅
1.351	40.8	0.85	DS	Results at 25°			
1.286	33.5	1.25	"	1.078	3.26	6.38	Na.1
1.278	32.5	1.34	" + Na ₅	1.092	7.32	4.80	"
1.251	29.6	6.25	Na ₅	1.149	16.08	3.68	"
Results at 5°				1.232	27.16	3.06	"
1.300	34.1	2.02	DS+Na ₅ +Na.1	1.328	38.19	2.60	"
1.042	4.50	1.58	Na.5	1.408	46.81	2.33	" + NaNO ₃
1.182	22.59	1.55	"	1.396	47.44	1.09	NaNO ₃
1.214	26.38	1.65	"	Results at 50°			
1.255	30.70	1.87	"	—	5.74	9.63	Na.1
1.275	32.48	2.07	"	—	17.03	6.22	"
1.291	34.34	1.94	" + DS	—	28.13	4.82	"
1.308	36.69	1.76	DS	—	39.15	3.92	"
1.324	38.38	1.60	"	—	41.53	3.84	" + Na
1.336	40.40	1.41	"	—	42.26	3.77	Na
1.359	42.74	1.28	" + NaNO ₃	—	45.23	3.46	"
1.359	42.94	1.01	NaNO ₃	—	49.23	3.09	"
Results at 8°				—	51.86	2.91	" + NaNO ₃
—	43.99	0.0	NaNO ₃	—	52.55	1.58	NaNO ₃
—	43.24	1.67	" + DS	t° = 70°	55.7	3.16	" + Na
—	40.80	1.88	DS	t° = 100°	61.5	3.94	" + "
—	39.54	1.96	" + Na.1				
—	39.36	2.02	Na.1				

Na₅ = NaIO₃.5H₂O; Na.1 = NaIO₃.H₂O; Na = NaIO₃; DS = 2NaIO₃.3NaNO₃.15H₂O.

SODIUM IODATE

EQUILIBRIUM IN THE SYSTEM SODIUM IODATE, SODIUM SULFATE AND WATER.
(Foote and Vance, 1930.)

Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase
NaIO ₃	Na ₂ SO ₄		NaIO ₃	Na ₂ SO ₄	
Results at 25°			Results at 35° (con.)		
3.76	12.64	NaIO ₃ ·H ₂ O	1.29	25.97	1.3
3.17	17.52	"	0.83	28.84	" + 1.4
2.79	21.18	" + Na ₂ SO ₄ ·10H ₂ O	0.30	30.35	1.4
2.20	21.30	Na ₂ SO ₄ ·10H ₂ O	0.28	31.06	"
			0.10	32.82	"
			0.15	32.88	" + Na ₂ SO ₄
Results at 29.5°			Results at 40°		
2.71	25.01	NaIO ₃ ·H ₂ O + 1.3			
1.90	25.68	1.3	5.30	19.97	NaIO ₃ ·H ₂ O + 1.3
1.52	26.85	"	4.01	21.21	1.3
1.57	27.72	" + Na ₂ SO ₄ ·10H ₂ O	2.75	22.85	"
			1.87	23.96	"
			1.25	25.93	"
			1.03	27.42	" + 1.4
4.47	15.30	NaIO ₃ ·H ₂ O	0.63	28.53	1.4
3.73	19.33	"	0.28	30.02	"
3.59	20.70	"	0.15	31.67	"
3.33	22.57	" + 1.3	0.15	31.65	" + Na ₂ SO ₄
2.39	23.79	1.3			

IO

1.3 = NaIO₃·3Na₂SO₄; 1.4 = NaIO₃·4Na₂SO₄.

SODIUM PER IODATE NaIO₃·3H₂O.

SOLUBILITY OF SODIUM PER IODATE IN WATER.
(Billa, 1929.)

t°	d. of sat. sol.	Gms. NaIO ₄ per 100 gms. sat. sol.	Solid Phase	t°	d. of sat. sol.	Gms. NaIO ₄ per 100 gms. sat. sol.	Solid Phase
5.8	1.048	3.93	NaIO ₄ ·3H ₂ O	34.5	—	21.3	NaIO ₄ ·3H ₂ O + NaIO ₄
15.0	1.060	7.2	"	31.5	1.173	19.8*	NaIO ₄
20	1.073	9.3	"	33.0	1.185	20.6*	"
25	1.103	12.62	"	35	1.192	21.5	"
30	1.143	16.6	"	38	1.202	22.6	"
31.5	1.161	18.2	"	44.2	1.218	24.9	"
33.0	1.175	19.6	"	51.5	1.251	28.0	"

* = Metastable.

Na NARIUM SODIUM Per IODATE

1272

EQUILIBRIUM IN THE SYSTEM SODIUM PERIODATE, SODIUM HYDROXIDE AND WATER AT 25°.

(Hill, 1928.)

d. of sat. sol.	Gms. per 100 gms. sat. sol.	gms. sat. sol.	Solid Phase	d. of sat. sol.	Gms. per 100 gms. sat. sol.	gms. sat. sol.	Solid Phase
	NaIO ₄	NaOH			NaIO ₄	NaOH	
1.103	12.62	0.0	NaIO ₄ ·3H ₂ O	1.006	0.30	0.55	Na ₂ H ₃ IO ₆
1.103	12.51	0.0	" + Na ₂ H ₃ IO ₆	1.004	0.33	0.57	" + Na ₂ H ₃ IO ₆
1.094	11.59	trace	Na ₂ H ₃ IO ₆	1.006	0.19	0.60	Na ₂ H ₃ IO ₆
1.057	7.63	0.02	"	1.010	0.15	1.00	"
1.011	1.85	0.01	"	1.032	0.08	2.41	"
0.999	0.22	0.045	"	1.111	0.02	10.04	"
1.000	0.15	0.17	"	—	0.004	22.2	"
1.002	0.31	0.45	"	1.319	trace	30.75	"

SOLUBILITY OF SODIUM PERIODATE IN AQUEOUS PERIODIC ACID AT 25°.

(Hill, 1928.)

d. of sat. sol.	Gms. per 100 gms. sat. sol.	gms. sat. sol.	Solid Phase
	NaIO ₄	HIO ₄	
1.103	12.62	0.0	NaIO ₄ ·3H ₂ O
1.150	11.43	5.23	"

MoO SODIUM MOLYBDATE Na₂MoO₄.

SOLUBILITY IN WATER.

(Funk, 1900a.)

t°.	Gms. Na ₂ MoO ₄ per 100 Gms. Solution.	Mols. Na ₂ MoO ₄ per 100 Mols. H ₂ O.	Solid Phase.	t°.	Gms. Na ₂ MoO ₄ per 100 Gms. Solution.	Mols. Na ₂ MoO ₄ per 100 Mols. H ₂ O.	Solid Phase.
0	30.63	3.86	Na ₂ MoO ₄ ·10H ₂ O	15.5	39.27	5.65	Na ₂ MoO ₄ ·2H ₂ O
4	33.83	4.47	"	18	39.40	5.70	"
6	35.58	4.83	"	32	39.82	5.78	"
9	38.16	5.39	"	51.5	41.27	6.14	"
10	39.28	5.65	Na ₂ MoO ₄ ·2H ₂ O	100	45.57	7.32	"

d of the sat. sol. at 18° is 1.437.

100 gms. H₂O dissolve 3.878 gms. sodium trimolybdate, Na₂Mo₃O₁₀, at 20°, and 13.7 gms. at 100°.

(Ullik, 1867.)

100 cc. H₂O dissolve 28.39 gms. Na₂O·4MoO₃·6H₂O at 21°, d₂₅ = 1.47. (Wempe, 1912.)

SODIUM MOLYBDATES, Para and Tri.

SOLUBILITY OF EACH IN WATER AT 30°. (Rosenheim, 1916.)

Compound.	Formula.	Gms. anhydrous compound per 100 gms. sat. sol.
Sodium para molybdate...	5Na ₂ O·12MoO ₃ ·38H ₂ O	54.06
Sodium tri molybdate....	Na ₂ Mo ₃ O ₁₀ ·7H ₂ O	13.68

Fusion-points of Na₂MoO₄ + MoO₃ are given by Hoermann, 1929.

Fusion-point data for Na₂MoO₄ + Na₂WO₄ and Na₂MoO₄ + Na₂SO₄ are given by Boeke (1907).

SOLUBILITY OF SODIUM AZIDE IN WATER.
(Schlegelmuth, 1934.)

t°	gms. NaN ₃ per 100 gms. sat. sol.	Solid Phase	t°	Gms. NaN ₃ per 100 gms. sat. sol.	Solid Phase
- 6	10.0	Ice	0	28.0	NaN ₃
-15.1 Eutec.	21.6	" + NaN ₃ · 3H ₂ O	+16	28.7 (1)	"
-20	" 26.8*	" + NaN ₃	20	29.0	"
- 8	24.0	NaN ₃ · 3H ₂ O	100	35.6	"
- 2, 100 pt.		" + Na ₂ CO ₃			

* Metastable; (1) Curtius and Rissom, 1898.

100 gms. alcohol of d₄ = 0.799 dissolve 0.22 gms. NaN₃ at 0° and 0.36 gms. at the h. pt.; 100 gms. benzene dissolve 0.10 gms. NaN₃ at the h. pt.
(Granston and Livingstone, 1926.)

SODAMMONIUM Na₂(NH₃)₂.

100 gms. liquid ammonia dissolve 60.5 gms. Na₂(NH₃)₂ at -23°, 56.4 gms. at 0°, 56 gms. at +15° and 55 gms. at 9°.
(Joannis, 1906.)

SODIUM NITRITE NaNO₂.

SOLUBILITY OF SODIUM NITRITE IN WATER.
(Bureau, 1934, 1937.)

t°	gms. NaNO ₂ per 100 gms. sat. sol.	Solid Phase	t°	d. of sat. sol.	Gms. NaNO ₂ per 100 gms. sat. sol.	Solid Phase
- 1.8	5.92	Ice	15	1.405	43.7	NaNO ₂
- 4.8	10.0	"	22	1.450	45.07	"
- 8.7	16.3	"	56.8	1.408	52.00	"
-11.5	21.0	"	64.7	1.422	54.07	"
-15.2	25.0	"	79.5	1.455	56.95	"
-19.5 Eutec.	28.1	" + NaNO ₂ · 1/2 H ₂ O	99.9	1.514	61.5	"
- 7.6	37.8	NaNO ₂ · 1/2 H ₂ O	103	—	62.6 (Oswald)	"
- 5.1	41.6	" + NaNO ₂	128	—	68.7	"
0	41.65	NaNO ₂				

The author shows that the previous results of Helberg, 1925, and Oswald, 1912, 1914, in the vicinity of the eutectic point, are erroneous. These authors also failed to detect the hemihydrate.

EQUILIBRIUM IN THE SYSTEM SODIUM NITRITE, SODIUM
CARBONATE AND WATER AT 23.1°.

(Bureau, 1937.)

d. of sat. sol.	Gms. per 100 gms. Na ₂ CO ₃	Gms. per 100 gms. sat. sol.	Solid Phase	d. of sat. sol.	Gms. per 100 gms. Na ₂ CO ₃	Gms. per 100 gms. sat. sol.	Solid Phase
1.152	0.0	46.25	NaNO ₂	1.363	30.18	11.61	Na ₂ · 10Na ₂ CO ₃
1.158	42.95	2.69	"	1.158	28.59	12.64	Na ₂ · 10
1.166	40.50	5.92	"	1.150	25.50	12.80	"
1.161	38.00	6.55	" + Na ₂ CO ₃	1.192	17.86	14.40	"
1.179	37.40	7.84	Na ₂ CO ₃	1.179	14.60	14.25	"
1.173	36.40	9.15	"	1.246	10.01	16.10	"
1.172	32.95	10.0	"	1.123	0.0	19.60	"

Na₂ · 1 = Na₂(C₂H₃O₂)₂ · 10H₂O, Na₂ · 10 = Na₂(C₂H₃O₂)₁₀ · 10H₂O.

EQUILIBRIUM IN THE SYSTEM SODIUM NITRITE, SODIUM
BICARBONATE AND WATER AT 23.1°.

(Bureau, 1937.)

d. of sat. sol.	Gms. per 100 NaHCO ₃	Gms. sat. sol. NaNO ₂	Solid Phase	d. of sat. sol.	Gms. per 100 NaHCO ₃	Gms. sat. sol. NaNO ₂	Solid Phase
1.352	0.0	45.25	NaNO ₂	1.288	1.58	36.92	NaHCO ₃
1.359	1.42	45.20	" + NaHCO ₃	1.256	1.20	32.90	"
1.348	1.00	44.0	NaHCO ₃	1.200	2.20	25.65	"
1.320	0.80	40.80	"	1.121	4.33	12.55	"
				2.082	9.91	0.0	"

The author also gives results for the system $\text{NaNO}_2 + \text{NaNO}_3$ at 0°, 18.5°, 56.1°, and 98.5°. His results agree closely with the following results of Oswald at 0°. His results at 18.5° are practically identical with those of Rakowski and Slavina, 1931, at 15°. His results at 56.1° are all under those of Oswald at 51° but at 98.5° they exceed Oswald's values at 103°, in the region where both salts are in excess.

SOLUBILITY OF SODIUM NITRITE IN AQUEOUS SOLUTIONS OF SODIUM
NITRATE AND VICE VERSA AT SEVERAL TEMPERATURES.

(Oswald, 1912, 1914.)

NO	Results at 0°.		Results at 21°.		Results at 52°.		Results at 103°.	
	Gms. per 100 NaNO ₂	Gms. H ₂ O. NaNO ₃	Gms. per 100 NaNO ₂	Gms. H ₂ O. NaNO ₃	Gms. per 100 NaNO ₂	Gms. H ₂ O. NaNO ₃	Gms. per 100 NaNO ₂	Gms. H ₂ O. NaNO ₃
	73	0	84.75	0	108.8	0	166	0
	68	19	81.1	9.6	104.3	20.6	153.3	33.2
	67	36.3	79.7	23.5	99.5	43.2	148.8	58.8
	64.9	41.7*	73.8	50.8	98.8	82 *	142.4	116 *
	50.3	46.8	73.1	54.5*	65.2	88	100	126.8
	30.2	55.4	64.2	56.7	44.2	92.9	60.1	142.9
	0	74.2	46.8	62.8	27.2	101.4	0	181.2
			21.6	74.7	14.7	109		
			0	89.3	0	118		

* Both salts in solid phase.

Similar results are also given for 18°, 65°, 81° and 92°.

100 gms. H₂O, simultaneously saturated with both salts, contain 53.9 gms. NaNO₂ + 11.8 gms. Na₂SO₄ at 16°. (Oswald, 1914.)

SOLUBILITY OF MIXTURES OF SODIUM NITRITE AND SILVER NITRITE IN WATER
AT 14° AND AT 22°.

(Oswald, 1912, 1914.)

Results at 14°.		Results at 22°.		Solid Phase in Each Case.
Gms. per 100 NaNO ₂	Gms. H ₂ O. AgNO ₂	Gms. per 100 NaNO ₂	Gms. H ₂ O. AgNO ₂	
55	15.2	58.3	21.5	AgNO ₂ + Na ₂ Ag ₂ (NO ₂) ₄ .H ₂ O
74.7	11.3	78.3	13.4	NaNO ₂ + Na ₂ Ag ₂ (NO ₂) ₄ .H ₂ O

100 gms. abs. methyl alcohol dissolve 4.43 gms. NaNO₂ at 19.5°.

100 gms. abs. ethyl alcohol dissolve 0.31 gm. NaNO₂ at 19.5°. (de Bruyn, 1892.)

100 gms. sat. solution of Sodium Nitrite in 94.9 Volume percent ethyl alcohol ($d_{25} = 0.810$) contain 1.424 gms. NaNO_2 (of 96.86% purity) at 25°. (Schneffbach and Rosin, 1929.)

F. pt. data for mixtures of $\text{NaNO}_2 + \text{NaNO}_3$ are given by Bruni and Meneghini, 1909, 1910.

SODIUM RHODONITRITE $\text{Na}_6\text{Rh}_2(\text{NO}_2)_{12}$.

100 gms. H_2O dissolve 40 gms. at 17°, and 100 gms. at 100°. (Leidie, 1890.)

SODIUM NITRATE NaNO_3 .

SOLUBILITY IN WATER.

(Mulder; Berkeley, 1904; see also Ditté, 1875; Maumee, 1864; Etard, 1894.)

t°.	Gms. NaNO_3 per 100 Gms.		Mols. per Liter.	t°.	Gms. NaNO_3 per 100 Gms.		Mols. per Liter.
	Solution.	Water.			Solution.	Water.	
0	42.2	72.9-73	* 6.71*	80	59.7	148-148.	* 10.35*
10	44.7	80.8-80.5	7.16	100	64.3	180-175.8	11.30
20	46.7	87.5-88	7.60	120	68.6	218-208.8†	12.22†
25	47.6	91-92	7.80	180	78.1	356.7	
30	48.7	94.9-96.2	8.06	220	83.5	506	
40	50.5	102-104.9	8.51	225	91.5	1076	
50	52.8	112-114	8.97	313†	100	∞	
60	54.9	122-124	9.42	...			

* Berkeley.

† at 119°.

‡ m.pt.

NO

More recent determinations of the Solubility of Sodium Nitrate in Water are as follows:

t°	d. of sat. sol.	Gms. NaNO_3 per 100 gms. sat. sol.	t°	d. of sat. sol.	Gms. NaNO_3 per 100 gms. sat. sol.
-18.1	Eutec.	38.07(1)	50	1.469	53.3(2) 53.1(4) 53.2(3)
-17.7	"	37.83(2)	65	—	56.0(5)
0	1.352	42.3 (2)(3)	75	1.469	58.6(2)(6)
15	—	45.93(4)	100	1.507	63.7(2)(3)
25	1.392	47.9(2) 47.8(4)(5)	118	1.535	67.4(2)

(1) Nikolajew, 1926; (2) Chretien, 1929; (3) Cornec & Neumeister, 1929; (4) Benrath et al. 1928; (5) Kurnakow & Nikolajew, 1926; (6) Schroder, 1930;

FREEZING-POINTS OF AQUEOUS SOLUTIONS OF SODIUM NITRATE.

(Klein and Svanberg, 1920; Rodobush, 1918.)

t° of f. pt.	Gms. NaNO_3 per 100 cc. sat. sol.	t° of f. pt.	Gms. NaNO_3 per 100 gms. H_2O .	t° of f. pt.	Gms. NaNO_3 per 100 gms. H_2O .
-0.340.....	0.85 (K and S)	-6.67.....	20.83	-12.85.....	44.56
-0.822.....	2.125	-8.78.....	28.77	-15.08.....	53.14
-1.583.....	4.25	-10.17.....	34.15	-17.46 Eutec.	62.50

100 gms. H_2O dissolve 84.86 gms. NaNO_3 at 16°.2, 87.81 gms. at 20° and 92.02 gms. at 25°. (Mondain-Monval, 1925.)

SOLUBILITY OF SODIUM NITRATE IN WATER AT TEMPERATURES
UP TO ITS MELTING POINT.

(Kracek, 1931.)

t°	Gms. NaNO ₃ per 100 gms.		t°	Gms. NaNO ₃ per 100 gms.	
	sat. sol.	H ₂ O		sat. sol.	H ₂ O
94.05	62.39	165.90	218.90	86.70	651.69
106.80	65.02	185.84	224.70	87.78	718.48
114.90	66.78	200.07	242.25	90.81	987.54
136.90	71.05	245.46	253.55	92.59	1248.80
151.60	74.06	285.53	260.90	93.71	1489.8
168.90	77.33	341.05	270.00	95.07	1926.2
178.00	79.11	378.72	289.20	97.59	4052.1
183.80	80.25	406.22	295.35	98.31	5828.9
201.60	83.57	508.62	309.5	100.0	—

More recent determinations agreeing in general with the above extremely accurate values of Kracek are given by Benrath, Gjedebø, Schiffers and Wunderlich, 1937.

SOLUBILITY OF SODIUM NITRATE IN AQUEOUS SOLUTIONS OF NITRIC ACID AT 0°.
(Engel, 1887; see also Schultz, 1860.)

NO

Equivalents per 10 cc. Solution.		Sp. Gr. of Solutions.	Grams per 100 cc. Solution.	
NaNO ₃ .	HNO ₃ .		NaNO ₃ .	HNO ₃ .
66.4	0	1.347	56.5	0.00
63.7	2.65	1.338	54.2	1.67
60.5	5.7	1.331	51.48	3.59
56.9	8.8	1.324	48.42	5.55
52.75	12.57	1.312	44.88	7.92
48.7	16.9	1.308	41.44	10.65
39.5	27.0	1.291	33.61	17.02
35.1	32.25	1.285	29.86	20.33
31.1	37.25	1.282	26.46	23.48
23.5	48.0	1.276	20.0	30.26
18.0	57.25	1.276	15.32	36.09
12.9	71.0	1.291	10.97	44.76

SOLUBILITY OF SODIUM NITRATE IN AQUEOUS SOLUTIONS OF NITRIC ACID.
(Kazantzev, 1923, 1925.)

Results at 15°.

Results at 75°.

Gms. per 100 gms. sat. sol.		Gms. per 100 gms. sat. sol.		Gms. per 100 gms. sat. sol.		Gms. per 100 gms. sat. sol.	
NaNO ₃ .	HNO ₃ .	NaNO ₃ .	HNO ₃ .	NaNO ₃ .	HNO ₃ .	NaNO ₃ .	HNO ₃ .
45.4	0.0	2.5	64.6	58.3	0.0	6.8	63.7
33.0	9.5	2.3	74.6	38.5	17.2	6.2	70.8
29.0	13.0	3.5	80.9	25.6	30.5	5.9	78.3
14.5	28.3	4.9	84.8	19.7	38.0	7.4	87.0
5.0	49.7	7.8	89.3	17.2	41.7	7.7	87.7
						8.1	88.9

SOLUBILITY OF SODIUM NITRATE IN AQUEOUS SOLUTIONS OF NITRIC ACID.
(Saslawsky, Ettlinger and Eserowa, 1935.)

Results at 0°

Gms. per 100 gms. sat. sol.		Solid Phase
NaNO ₃	HNO ₃	
42.77	0.0	NaNO ₃
20.99	20.50	"
4.32	42.70	"
2.10	62.81	"
1.59	72.76	"
4.39	85.88	"

Results at 20°

Gms. per 100 gms. sat. sol.		Solid Phase
NaNO ₃	HNO ₃	
46.27	0.0	NaNO ₃
23.69	18.98	"
6.14	41.52	"
2.13	59.66	"
2.00	72.01	"
5.53	84.77	"

The authors also give results for the quaternary system $\text{Al}(\text{NO}_3)_3 + \text{NaNO}_3 + \text{HNO}_3 + \text{H}_2\text{O}$ at 0° and 20°.

SOLUBILITY OF SODIUM NITRATE IN AQUEOUS SOLUTIONS
OF HYDROGEN PEROXIDE AT 25°.

(Akerlof and Turck, 1935.)

Wt. Percent H₂O₂
in solvent0.0
15.72
31.43Gm. Mols. NaNO₃ per
1000 gms. solvent10.825
9.252
7.554

NO

SOLUBILITY OF SODIUM NITRATE IN HYDROGEN PEROXIDE.

(Maass and Hatcher, 1922.)

The temperature were determined at which the last trace of solid disappeared in mixtures of weighed amounts of the two constituents.

t°.	Gms. NaNO ₃ per 100 gms. sat. sol.	t°.	Gms. NaNO ₃ per 100 gms. sat. sol.	t°.	Gms. NaNO ₃ per 100 gms. sat. sol.
-2.47.....	1.62	-5.62....	10.11	-10.82....	22.25
-2.82.....	3.23	-6.97....	13.19	+11.8.....	25.22
-3.72.....	5.11	-8.12....	16.66	32.3.....	28.25
-4.72.....	7.58	-9.52....	20.19	49.3.....	31.53

SOLUBILITY OF MIXTURES OF SODIUM NITRATE AND POTASSIUM NITRATE
IN WATER AT 20°.

(Carnelly and Thomson, 1888.)

Per cent NaNO ₃ in Mixtures Used	Gms. per 100 Gms H ₂ O.		Per cent NaNO ₃ in Mixtures Used.	Gms. per 100 Gms. H ₂ O.	
	NaNO ₃ .	KNO ₃ .		NaNO ₃ .	KNO ₃ .
100	86.8	0	45.7	53.3	34.7
90	96.4	13.2	40	45.6	35.5
80	98.0	38.5	20	20.8	33.3
60	90.0	47.6	10	9.4	31.5
50	66.0	40.0	0	0.0	33.6

100 gms. H₂O dissolve 24.9 gms. NaCl + 53.6 gms. NaNO₃ at 20°.

(Rüdorff, 1873; Karsten; Nicol, 1891.)

SOLUBILITY OF MIXTURES OF SODIUM NITRATE AND SODIUM CHLORIDE
IN WATER AT VARIOUS TEMPERATURES.

(Nikolajew, 1929.)

t°	Gms. per 100 gms. sat. sol.		Solid Phase	t°	Gms. per 100 gms. sat. sol.		Solid Phase
	NaCl	NaNO ₃			NaCl	NaNO ₃	
15	16.54	23.68	NaNO ₃ + NaCl	130	3.92	66.09	NaNO ₃ + NaCl
25	13.34	31.47	"	162	4.10	72.21	"
35	11.62	36.12	"	185	4.8	76.8	"
72.6	7.66	49.33	"	196	6.2	79.8	"
100	5.54	58.25	"	210	7.4	82.2	"

The author also gives results for the effect of varying concentrations of NaOH upon the simultaneous solubility of NaNO₃ and NaCl at 15° and at 25°. The results show the partition of NaOH between HCl and HNO₃.

Results for the Reciprocal Salt Pair Na₂(NO₃)₂ + MgSO₄ + H₂O at various temperatures are given by Benrath, 1928, and Schrodor, 1929.

SOLUBILITY OF SODIUM NITRATE IN AQUEOUS AMMONIA SOLUTIONS AT 15°.

(Fedotieff and Koltunoff, 1914.)

In Aqueous NH₃.

d ₁₅ of Sat. Sol.	Gms. per 100 Gms. H ₂ O.	
	NH ₃	NaNO ₃
1.253	13.87	75.03
1.233	17.28	73.99
1.212	20.38	73.18

In Aqueous NH₃ + NH₄NO₃.

d ₁₅ of Sat. Sol.	Gms. per 100 Gms. H ₂ O.		
	NH ₃	NH ₄ NO ₃	NaNO ₃
1.324	12.91	83.51	74.10
1.330	16.97	128.9	69.40

NO

SOLUBILITY OF SODIUM NITRATE IN AQUEOUS AMMONIA SOLUTIONS AT 0°.

(Auer, Bieber and Schmid, 1934.)

The authors given their results only in the form of a diagram from which the following approximate values were read.

Gms. per 100 gms. sat. sol.		Gms. per 100 gms. sat. sol.	
NH ₃	NaNO ₃	NH ₃	NaNO ₃
0	42.3	60	39.5
10	36	70	43
20	31.5	80	47
28	30	90	52
40	33	100	55
50	36.5		

SOLUBILITY OF SODIUM NITRATE IN AQUEOUS SOLUTIONS OF SODIUM
HYDROXIDE AT 0°.

(Engel, 1891.)

Milligram Mols. per 10 cc. Solution.		Sp. Gr. of Solutions.	Grams per 100 cc. Solution.	
Na ₂ O.	NaNO ₃		NaOH.	NaNO ₃ .
0.0	66.4	1.341	0.0	56.50
2.875	62.5	1.338	2.30	53.19
6.1	57.15	1.333	4.89	48.63
12.75	47.5	1.327	10.21	40.42
26.0	29.5	1.326	20.83	25.10
39.0	17.5	1.332	31.25	14.89
45.88	13.19	1.356	36.76	11.22
60.88	6.05	1.401	48.75	5.15

Results for equilibrium in the system Sodium Nitrate, Sodium Hydroxide and Water at 0°, 25° and 65° are given by Kurnakow and Nikolajew, 1927. The isotherms for 100° and 125° and the complete temperature concentration diagrams for the system are given by Jänecke, 1930.

EQUILIBRIUM IN THE SYSTEM SODIUM NITRATE, SODIUM SULFATE AND WATER.

(Chretien, 1929.)

t°	d. of sat. sol.	Gms. per 100 gms. sat. sol.		Solid Phase	t°	d. of sat. sol.	Gms. per 100 gms. sat. sol.		Solid Phase
		NaNO ₃	Na ₂ SO ₄				NaNO ₃	Na ₂ SO ₄	
-17.8	—	37.7	0.12	Ice+N+S.10	25	1.405	45.2	3.04	1.1.2+N
-10.6	—	25.0	1.32	" + S.10	"	1.398	46.5	1.57	N
-10.6	—	39.2	0.56	N + S.10	30	1.327	8.51	29.9	S.10+S
-4.0	—	8.99	2.82	Ice+S.10	"	1.351	29.9	11.30	1.1.2+S
-4.0	—	40.7	0.82	N + S.10	"	1.411	46.6	2.80	" + N
-1.0	—	41.3	1.09	" + "	35	1.315	13.3	21.6	S
0	1.128	14.6	1.76	S.10	"	1.328	25.5	13.8	"
"	1.222	27.7	1.17	"	"	1.352	32.4	9.77	"
"	1.398	35.3	1.15	"	"	1.357	33.9	8.97	" + 1.1.2
"	1.343	39.7	1.07	"	"	1.360	36.1	7.51	1.1.2
"	1.355	41.2	1.07	" + N	"	1.374	40.2	5.41	"
"	1.352	41.6	0.0	N	"	1.415	47.2	2.65	"
6.5	—	41.9	2.12	" + S.10	"	1.417	48.0	2.53	" + N
10.2	1.382	41.8	3.08	"	50	1.219	12.9	30.7	S
15.0	1.381	39.2	5.11	D + "	"	1.302	23.6	13.3	"
"	1.494	42.0	4.09	N + 1.1.2	"	1.330	33.2	8.27	"
17.5	1.467	36.3	6.66	S.10 + "	"	1.365	39.9	5.67	"
"	1.495	42.8	3.78	N + "	"	1.388	43.9	4.43	" + 1.1.2
20	1.303	13.3	10.91	S.10	"	1.392	44.5	4.23	1.1.2
"	1.270	21.8	9.20	"	"	1.407	46.8	3.35	"
"	1.335	30.5	8.9	"	"	1.422	49.5	2.61	"
"	1.356	33.1	8.62	"	"	1.440	51.6	2.13	" + N
"	—	34.1	8.09	1.1.2	"	1.432	52.2	1.21	N
"	1.366	36.3	6.73	"	75	1.256	13.9	18.4	S
"	—	41.2	4.56	"	"	1.281	27.8	10.02	"
"	—	42.7	3.85	"	"	1.346	41.2	4.73	"
"	1.397	43.6	3.46	" + N	"	1.416	50.7	2.62	"
"	—	44.8	2.27	N	"	1.464	55.8	1.95	"
24.3	1.348	26.3	13.9	1.1.2+S.10+S	"	1.478	57.2	1.86	" + N
25	1.356	12.6	16.5	S.10	"	1.475	57.6	1.25	N
"	1.315	21.2	14.8	"	83	1.491	59.0	1.70	" + S
"	1.346	24.9	14.6	" + S	91	1.505	60.8	1.64	"
"	—	25.9	13.9	S	100	1.230	13.6	17.8	S
"	1.350	26.8	13.3	" + 1.1.2	"	1.247	24.9	10.9	"
"	1.351	27.7	12.70	1.1.2	"	1.321	40.5	4.9	"
"	1.350	29.5	11.30	"	"	1.403	51.3	2.77	"
"	1.354	31.1	10.20	"	"	1.466	58.1	1.97	"
"	1.368	37.7	6.17	"	"	1.515	62.6	1.57	" + N
"	1.393	43.1	3.74	"	"	1.514	63.1	0.86	N
"	1.404	44.6	3.40	"	120.3 b. pt.	—	66.2	1.48	" + S

S.10 = Na₂SO₄ · 10H₂O; S = Na₂SO₄; N = NaNO₃; 1.1.2 = NaNO₃ · Na₂SO₄ · 2H₂O. The author also gives results for the system NaNO₃ + NaCl + Na₂SO₄ + H₂O.

Less complete results differing in certain details from the above are given by Masarik, 1918, Foote, 1925 and Hamid, 1926. Other results in general agreement with the above are given by Benrath, 1928, in connection with a study of the equilibrium in the reciprocal salt pair Na₂(NO₃)₂ + MgSO₄ + H₂O, at 15°, 25°, 50° and 97°.

SOLUBILITY OF SODIUM NITRATE IN AQUEOUS SOLUTIONS OF SODIUM THIOSULFATE.

(Kremann and Rodemund, 1914.)

Results at 9°.

Gms. per 100 Gms. Sat. Sol.		Solid Phase.
NaNO ₃ .	Na ₂ S ₂ O ₃ .	
33.31	12.26	NaNO ₃
22.57	23.41	" + Na ₂ S ₂ O ₃ ·5H ₂ O
4.22	34.77	Na ₂ S ₂ O ₃ ·5H

Results at 25°.

Gms. per 100 Gms. Sat. Sol.		Solid Phase.
NaNO ₃ .	Na ₂ S ₂ O ₃ .	
35.42	12.72	NaNO ₃
25.40	24.25	"
19.90	31.81	" + Na ₂ S ₂ O ₃ ·5H ₂ O
18.02	32.83	Na ₂ S ₂ O ₃ ·5H ₂ O
4.33	40.50	"

SOLUBILITY OF SODIUM NITRATE IN ALCOHOLS.

100 gms. abs. methyl alcohol dissolve 0.41 gm. NaNO₃ at 25°.100 gms. abs. ethyl alcohol dissolve 0.036 gm. NaNO₃ at 25°. (de Bruyn, 1892.)

SOLUBILITY OF SODIUM NITRATE IN AQUEOUS ETHYL ALCOHOL AT DIFFERENT TEMPERATURES.

(Bodländer, 1891; Taylor, 1897; Bathrick, 1896.)

Results at 13° (B.).

Sp. Gr. of Solutions.	Gms. per 100 cc. Solution.		
	C ₂ H ₅ OH.	H ₂ O.	NaNO ₃ .
1.3700	0.0	75.34	61.66
1.3395	3.08	73.53	57.34
1.3120	6.01	71.81	53.39
1.2845	8.30	70.85	49.30
1.2580	10.91	69.47	45.42
1.2325	13.77	67.12	42.36
1.2010	16.46	66.16	37.48

Results at 16.5° (B.).

Sp. Gr. of Solutions.	Gms. per 100 cc. Solution		
	C ₂ H ₅ OH.	H ₂ O.	NaNO ₃ .
1.3745	0.0	75.25	62.20
1.3162	6.16	70.82	54.64
1.2576	11.60	68.10	46.06
1.2140	16.49	65.04	39.87
1.1615	22.17	61.67	32.31
1.0855	32.22	52.92	23.41
1.0558	37.23	48.50	19.85
1.0050	43.98	42.78	13.74
0.9420	52.60	32.13	9.47
0.9030	60.00	25.65	4.65
0.8610	63.16	21.31	1.63

Results at 30° (T.).

Wt. per cent Alcohol in Solvent.	Gms. NaNO ₃ per 100 Gms.	
	Solution.	Water.
0	49.10	96.45
5	46.41	91.15
10	43.50	85.55
20	37.42	74.75
30	31.31	65.10
40	25.14	55.95
50	18.94	46.75
60	12.97	37.25
70	7.81	28.25
90	1.21	12.25

Results at 40° (Bathrick).

Wt. per cent Alcohol	Gms. NaNO ₃ per 100 Gms. Aq. Alcohol.
0	104.5
8.22	90.8
17.4	73.3
26.0	61.6
36.0	48.4
42.8	40.6
55.3	27.1
65.1	18.1
77.0	9.4
87.2	4.2

SOLUBILITY OF SODIUM NITRATE IN AQUEOUS SOLUTIONS OF URANYL
NITRATE AND VICE VERSA AT 25°.

(Colani, 1922.)

Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase
UO ₂ (NO ₃) ₂	NaNO ₃		UO ₂ (NO ₃) ₂	NaNO ₃	
0.0	47.78	NaNO ₃	45.37	14.39	UO ₂ (NO ₃) ₂ ·6H ₂ O
9.12	40.06	"	48.62	9.43	"
20.83	31.71	"	51.59	6.06	"
34.35	22.26	"	53.06	3.45	"
40.76	17.58	"	56.08	0.0	"
44.20	16.20	" + UO ₂ (NO ₃) ₂ ·6H ₂ O			

SOLUBILITY OF SODIUM NITRATE IN AQUEOUS SOLUTIONS OF
METHYL ALCOHOL AT 25°.

(Akerlof and Turck, 1935.)

Wt. % CH ₃ OH in solvent	Gm. Mols. NaNO ₃ per 1000 gms. solvent	Wt. % CH ₃ OH in solvent	Gm. Mols. NaNO ₃ per 1000 gms. solvent
0.0	10.825	70.05	1.364
21.30	7.111	78.46	0.893
40.10	4.172	89.45	0.543
59.94	2.076	100.0	0.485

100 gms. aq. 50% Ethyl Alcohol dissolve 19.4 gms. NaNO₃ at 20°.
(Wright, 1926.)

SOLUBILITY OF SODIUM NITRATE IN AQUEOUS ALCOHOL AT 25°.

(Armstrong and Eyre, 1910-11.)

Solvent.		Gms. NaNO ₃ per 100 Gms. Sat. Sol.
Mols. C ₂ H ₅ OH per 1000 Gms. H ₂ O.	Gms. C ₂ H ₅ OH per 1000 Gms. H ₂ O.	
0	0	47.93
0.25	11.51	47.32
0.50	23.03	46.73
1	46.06	45.43
2	92.12	43.04

SOLUBILITY OF SODIUM NITRATE IN AQUEOUS SOLUTIONS OF ACETONE.

Results at 30°.

(Taylor, 1897.)

Results at 40°.

(Bathrick, 1896.)

Wt. per cent Acetone in Solvent.	Gms. NaNO ₃ per 100 Gms.		Wt. per cent Acetone.	Gms. NaNO ₃ per 100 Gms. Aq. Acetone.
	Solution.	Water.		
0	49.10	96.45	0.0	105
5	46.96	93.20	8.47	91.2
9.09	45.11	90.40	16.8	78.3
20	40.10	83.70	25.2	66.4
30	35.08	77.20	34.3	57.9
40	29.80	70.75	44.1	46.2
50	24.34	64.40	53.9	32.8
60	18.55	59.95	64.8	23.0
70	13.15	50.50	76.0	10.8
80	7.10	38.20	87.6	3.2
90	1.98	20.20		

100 gms. hydroxylamine dissolve 13.1 gms. NaNO₃ at 17-18°. (de Bruyn, 1892.)
100 cc. anhydrous hydrazine dissolve 100 gms. NaNO₃ at room temp.

(Welsh and Broderson, 1915.)

SOLUBILITY OF SODIUM NITRATE IN ANHYDROUS ACETIC ACID
DETERMINED BY THE FREEZING-POINT METHOD.

(Davidson and Geer, 1933.)

t°	Mol. % NaNO ₃ in sat. sol.	Solid Phase	t°	Mol. % NaNO ₃ in sat. sol.	Solid Phase
16.60	0.0	CH ₃ COOH	46.5	0.202	NaNO ₃
16.53	0.031	"	53.7	0.246	"
16.45	0.150	"	78.5	0.448	"
27.0	0.122	NaNO ₃	88.3	0.573	"
31.5	0.150	"	93.4	0.641	"
36.0	0.166	"	95.7	0.677	"
40.0	0.173	"	103.0	0.854	"

SOLUBILITY OF SODIUM NITRATE IN UREA (CARBAMIDE) DETERMINED
BY THE FREEZING-POINT METHOD.

(Howells, 1930.)

t°	Wt. % NaNO ₃ in sat. sol.	Solid Phase	t°	Wt. % NaNO ₃ in sat. sol.	Solid Phase
132.0	0.0	CO(NH ₂) ₂	88.4	30.5	NaNO ₃
121.4	6.9	"	92.5	31.1	"
106.8	16.3	"	109.0	33.2	"
95.8	23.22	"	131.7	36.69	"
88.8	27.0	"	156.0	41.30	"
83.9	29.5	" + NaNO ₃			

NO

The author also gives complete results for the ternary system NaNO₃ + NH₄NO₃ + CO(NH₂)₂.

EQUILIBRIUM IN THE SYSTEM SODIUM NITRATE, Iso PROPYL ALCOHOL
AND WATER AT 25°.

(Ginnings and Chen, 1931.)

Points on the binodal curve of this system were determined by titrating mixtures of the salt and one of the liquids with the other liquid until clouding appeared or disappeared. Tie lines, *, were located by means of determinations of the salt in two layers in contact with each other. The plait point, PP, was found by plotting.

Gms. per 100 gms. of the homogeneous mixture		Gms. per 100 gms. of the homogeneous mixture	
NaNO ₃	CH ₃ CH(OH)CH ₃	NaNO ₃	CH ₃ CH(OH)CH ₃
10.90	49.50 *	29.25	11.54
14.5	39.50	32.65	8.20
17.17	33.80	37.70	4.90
18.20	31.50	40.56	4.04
21.5	26.0 PP	43.80	3.00 *
24.4	19.5		

The composition of the plait point, determined in a manner similar to the above, for the system Sodium Nitrate, Tertiary Butyl Alcohol and Water at 25° was found by Ginnings, Herring and Webb, 1933, to be 32.4 wt. percent NaNO₃ + 11.6 wt. percent (CH₃)₃COH

Ginnings and Dees, 1935, and Ginnings, Webb and Hinojara, 1933, have respectively determined the binodal curves for the systems Sodium Nitrate, Allyl Alcohol and Water at 25° and Sodium Nitrate Pyridine and Water at 25°, but the original results are not given but only the values of constants for the curves calculated by means of empirical equations.

100 cc Pyridine dissolve 0.34 gm. NaNO₃ at 25°. (Müller, 1928.)

SODIUM NITRATE

SOLUBILITY OF SODIUM NITRATE IN LIQUID AMMONIA.

t°	Gms. NaNO ₃ per 100 cc sat. sol.	t°	Gms. NaNO ₃ per 100 gms. NH ₃
-50.5	47.3 (1)	-53.0	99.2 (2)
-49.0	50.3 (1)	-37	110.9 (2)
-48.0	52.3 (1)	0	126.4 (2)
-47.5	53.3 (1)	+0.1	127.5 (3)
-47.6	55.8 (1)	25	97.6 (4)
-48.0	58.5 (1)	30	137.4 (2)
-50.2	59.9 (1)	48	143.6 (2)
-48.6	61.2 (1)	60	148.5 (2)
-49.8	63.1 (1)		

(1) Scherer, 1931; (2) Portnow and Rawdine (3) Linhard and Stephan, 1933, 1934; (4) Hunt, 1932.

Fusion-point data are given for:

NaNO ₃ + KNO ₃ + SrNO ₃	(Harkins and Clark, 1915.)
" + NaOH	(Retortillo and Moles, 1933.)
" + Pb(NO ₃) ₂	(Glass, Laybourn and Madgin, 1932.)
" + " + Sr(NO ₃) ₂	(Laybourn, Madgin and Freeman, 1934.)
" + RbNO ₃	(Puschin and Radoicic, 1937.)
" + TlNO ₃	(Van Eyk, 1905.)

SODIUM HYDROXIDE Na OH.

FREEZING-POINTS OF DILUTE AQUEOUS SOLUTIONS OF SODIUM HYDROXIDE
(Klein and Svanberg, 1920.)

t° of f. pt.	-0.35.	-0.867.	-1.72.
Normality of aq. Na OH	0.1	0.25	0.50

FREEZING-POINTS OF MIXTURES OF SODIUM HYDROXIDE AND WATER.
(Von Antropoff and Sommer, 1926.)

t° of beginning of crystallization.	t° of transition.	t° of eutec.	Gms. per 100 gms. of mixture.	
			Na OH.	H ₂ O.
322	303	-	100.0	0.9
319	305	48	98.7	1.3
298	-	53	96.7	3.3
265	-	56	91.7	8.4
205	-	56	85.5	14.5
-	-	58	76.2	23.8

The authors also give data for the system Na OH + Na Cl + H₂ O.

SODIUM HYDROXIDE NaOH.

SOLUBILITY IN WATER.

(Pickering, 1893; Mylius and Funk (Dietz), 1900.)

t°.	Gms. NaOH per 100 Gms.		Solid Phase.	t°.	Gms. NaOH per 100 Gms.		Solid Phase.
	Solution.	Water.			Solution.	Water.	
- 7.8	8.0	8.7	Ice	20	52.2	109	NaOH.H ₂ O
-20	16.0	19.1	"	30	54.3	119	"
-28	19.0	23.5	Ice + NaOH.7H ₂ O	40	56.3	129	"
-24	22.2	28.5	NaOH.7H ₂ O + NaOH.5H ₂ O	50	59.2	145	"
-17.7	24.5	32.5	NaOH.5H ₂ O + NaOH.4H ₂ O α	60	63.5	174	"
0	29.6	42.0	NaOH.4H ₂ O α	64.3	69.0	222	3 " f. pt.
+ 5	32.2	47.5	NaOH.4H ₂ O α + NaOH.3½H ₂ O	61.8	74.2	288	NaOH.H ₂ O + NaOH
10	34.0	51.5	NaOH.3½H ₂ O	80	75.8	313	NaOH (?)
15.5	38.9	63.53	" f. pt.	110	78.5	365	"
5	45.5	83.5	NaOH.3½H ₂ O + NaOH.2H ₂ O	192	83.9	521	"
12	50.7	103.0	NaOH.2H ₂ O + NaOH.H ₂ O				

Sp. Gr. of sat. solution at 18° = 1.539.

For determinations of the Sp. Gr. of sodium hydroxide solution, see Kohlrausch, 1879; Wegscheider and Walter, 1905.

100 gms. of the sat. solution in water contain 46.36 gms. NaOH at 15°.

(de Forcrand, 1909a.)

OH

100 gms. H₂O dissolve 2.83 gm. mols. NaOH at 25°. (Akerlof and Short, 1937.)

100 gms. sat. solution of sodium hydroxide in water contain 51.33 gms. NaOH at 25°, determined by E.M.F. measurements. (Shibata, 1932.)

SOLUBILITY OF SODIUM HYDROXIDE IN WATER AT HIGH TEMPERATURES.

(v. Antropoff and Sommer, 1926.)

t°	Gms. NaOH per 100 gms. sat. sol.
205	85.5
265	91.6
295	96.7
322(m. pt.)	100.0

1000 gms. liquid ammonia dissolve 0.0025 gm. NaOH at -40°.

(Skossareswky and Tchitchinadze, 1916.)

Data for equilibrium in the system sodium hydroxide, resorcinol and water at 30° are given by van Meurs (1916).

EQUILIBRIUM IN THE SYSTEM SODIUM HYDROXIDE, SODIUM SULFITE AND WATER
(Hammick and Currie, 1925.)

The mixtures were constantly stirred for 24 to 48 hours. Silver vessels were used for the stronger sodium hydroxide solutions. Both the saturated solutions and the solid phases were analyzed. The temperatures were constant to within 0.1° . The results are probably accurate to ± 0.5 per cent.

Gms. per 100 gms. sat. sol.			Gms. per 100 gms. sat. sol.		
Na OH.	Na ₂ SO ₃ .	Solid Phase.	Na OH.	Na ₂ SO ₃ .	Solid Phase.
Results at 0.15° .			Results at 25° .		
29.5	0.0	Na OH. 4 H ₂ O	53.3	0.0	Na OH. H ₂ O
29.1	0.1	" + Na ₂ SO ₃	43.9	trace	Na ₂ SO ₃
27.9	0.1	Na ₂ SO ₃	42.7	0.1	"
27.1	0.4	"	29.4	0.3	"
26.6	0.7	"	28.7	0.5	"
25.4	1.3	"	25.2	1.0	"
23.3	2.2	" + Na ₂ SO ₃ . 7 H ₂ O	20.7	2.5	"
21.9	2.21	Na ₂ SO ₃ . 7 H ₂ O	20.7	2.9	"
16.9	2.8	"	17.2	5.8	"
9.0	5.2	"	14.2	8.2	"
3.0	9.0	"	12.6	10.1	"
0.0	12.3	"	12.2	10.2	"
Results at 20° .			9.6	13.8	" + Na ₂ SO ₃ . 7 H ₂ O
52.2	0.0	Na OH. H ₂ O	9.8	13.2	" "
50.1	trace	Na ₂ SO ₃	9.7	13.0	Na ₂ SO ₃ . 7 H ₂ O
36.3	0.1	"	5.0	17.7	"
26.8	1.0	"	2.5	19.3	"
24.9	1.1	"	0.7	22.5	"
20.2	3.5	"	0.0	23.6	"
16.0	6.7	"	Results at 32° .		
15.5	7.0	"	54.4	0.0	Na OH. H ₂ O
13.8	8.6	" + Na ₂ SO ₃ . 7 H ₂ O	51.8	0.001	Na ₂ SO ₃
14.0	9.0	" "	36.2	0.1	"
13.4	9.2	Na ₂ SO ₃ . 7 H ₂ O	27.2	0.6	"
12.7	9.4	"	20.1	2.9	"
12.2	9.6	"	16.5	5.4	"
11.6	9.9	"	11.1	11.2	"
9.9	11.0	"	7.6	15.7	"
8.3	12.0	"	5.1	19.1	"
4.4	15.4	"	2.3	23.1	"
1.6	18.7	"	0.6	26.4	"
0.0	21.3	"	0.0	26.5	"

OH

SOLUBILITY OF SODIUM HYDROXIDE IN METHYL ALCOHOL AND
IN ETHYL ALCOHOL AT ABOUT 28° .

(Murray, 1929.)

The mixtures were shaken occasionally at room temperature during about three weeks. Portions of the clear supernatant solutions were then removed, weighed and titrated with normal sulfuric acid.

Solvent	d. of sat. sol.	Normality of sat. sol.	Gms. NaOH per:	
			100 cc sat. sol.	100 gms. sat. sol.
Methyl Alcohol	1.01	5.98	23.9	23.6
Ethyl Alcohol	0.93	3.40	13.6	14.7

EQUILIBRIUM IN THE SYSTEM SODIUM-HYDROXIDE, ACETONE AND WATER AT 0°. (Gibby, 1934.)

The binodal curve was determined by titration of acetone into aqueous sodium hydroxide solutions until a permanent separation into two layers was observed. Tie lines were located by preparing mixtures which yielded sufficient amounts of the two layers for titrating the alkali in each.

Gms. per 100 gms. homogeneous mixture		Gms. per 100 gms. homogeneous mixture		Gms. per 100 gms. homogeneous mixture	
KOH	(CH ₃) ₂ CO	KOH	(CH ₃) ₂ CO	KOH	(CH ₃) ₂ CO
0.0	— * * *	4.4	41.7	25.0	— *
0.4	80.1	8.2	26.6	27.2	2.0
0.6	70.1	15.1	11.1	28.4	1.3
0.7	70.5	17.9	7.8	29.8	— *
1.7	58.6	20.7	5.5	37.9	— *
2.2	55.1	21.3	5.2	43.8	0.4
3.0	50.4				

* Tie lines.

PO SODIUM Hydro PHOSPHITE Na₂HPO₃·5½H₂O.

SOLUBILITY OF SODIUM HYDROPHOSPHITE IN WATER. (Rosenheim and Reglin, 1921.)

t°.	Gms. Na ₂ HPO ₃ per 100 gms. sat. sol.	t°.	Gms. Na ₂ HPO ₃ per 100 gms. sat. sol.
0.....	80.72	30.....	84.96
20.....	81.06	38.....	91.94
25.....	82.21	43.....	92.70

SODIUM PHOSPHITES

SOLUBILITY OF SODIUM PHOSPHITES, ETC., IN WATER.

Salt.	Formula.	t°.	Gms. Salt per 100 Gms. H ₂ O.	Authority.
Hydrogen Phosphite	(NaH)HPO ₃ ·2½H ₂ O	0	56	(Amat.—Compt. rend. 106, 1351, '88.)
"	"	10	66	
"	"	42	193	
Hypophosphate	Na ₂ P ₂ O ₆ ·10H ₂ O	cold	3.3	(Salzer—Liebig's Ann. 212, 1, '82.)
Hydrogen Hypophosphate	Na ₂ HP ₂ O ₆ ·9H ₂ O	?	4.5	
Tri Hydrogen "	NaH ₂ P ₂ O ₆ ·3H ₂ O	cold	6.7	
Di Hydrogen "	Na ₂ H ₂ P ₂ O ₆ ·6H ₂ O	cold	2.2	(Salzer—Liebig's Ann. 187, 331, '77.)
Di Hydrogen "	Na ₂ H ₂ P ₂ O ₆ ·6H ₂ O	b. pt.	20.0	
Hypophosphite	(NaH)HPO ₂ ·H ₂ O	25	100.0	
Hypophosphite	(NaH)HPO ₂ ·H ₂ O	b. pt.	83.0	(U. S. P.)

100 gms. H₂O dissolve 108.7 gms. anhydrous sodium hypophosphite (NaH₂PO₂) at 15°, d₁₅ of sat. sol. = 1.388. (Greenish and Smith, 1901.)

Tri **SODIUM PHOSPHATE** (Ortho) $\text{Na}_3\text{PO}_4 \cdot 12\text{H}_2\text{O}$.

SOLUBILITY OF TRI SODIUM PHOSPHATE IN WATER. (Apfel, 1911.)

The saturated solutions were prepared by constant stirring in a thermostat. The author's determinations were calculated to the gram basis, plotted on cross section paper and the following values taken from the curve. The solid phases were identified only by estimation of their water of crystallization.

t°.	Gms. Na_3PO_4 per 100 gms. sat. sol.	Solid Phase.	t°.	Gms. Na_3PO_4 per 100 gms. sat. sol.	Solid Phase.
0.....	4.3	$\text{Na}_3\text{PO}_4 \cdot 12\text{H}_2\text{O}$	50.....	22.7	$\text{Na}_3\text{PO}_4 \cdot 10\text{H}_2\text{O}$
10.....	7.6	"	55.....	26.2	"
20.....	10.8	"	60.....	28.5	"
25.....	12.3	"	65.....	30.2	"
30.....	14.0	"	70.....	32.7	$\text{Na}_3\text{PO}_4 \cdot 8\text{H}_2\text{O}$
40.....	16.8	"	75.....	35.1	"

SODIUM (Hydrogen) **PHOSPHATE**

SOLUBILITY OF TRI SODIUM PHOSPHATE IN WATER AT TEMPERATURES UP TO 350° .
(Schroeder, Berk and Gabriel, 1937.)

The authors' determinations were plotted and the following values taken from the smoothed curve.

PO

t°	Gms. Na_3PO_4 per 100 gms. H_2O	Solid Phase	t°	Gms. Na_3PO_4 per 100 gms. H_2O	Solid Phase
75	57.0	$\text{Na}_3\text{PO}_4 \cdot 10\text{H}_2\text{O} +$ $\text{Na}_3\text{PO}_4 \cdot 8\text{H}_2\text{O} (?)$	180	67	$\text{Na}_3\text{PO}_4 \cdot \text{H}_2\text{O}$
80	60.0	$\text{Na}_3\text{PO}_4 \cdot 8\text{H}_2\text{O} (?)$	200	61	"
90	68.0	"	215	59	" + Na_3PO_4
100	77.0	"	216	46	Na_3PO_4
110	86.0	"	218	40	"
121	94.0	" + $\text{Na}_3\text{PO}_4 \cdot \text{H}_2\text{O}$	220	37	"
130	90.0	$\text{Na}_3\text{PO}_4 \cdot \text{H}_2\text{O}$	230	22	"
140	85.0	"	240	14	"
150	80.0	"	250	9.5	"
160	76.0	"	300	2.5	"
			350	0.15	"

SOLUBILITY OF Na_3PO_4 IN AQUEOUS SOLUTIONS OF SODIUM HYDROXIDE.
(Schroeder, Berk and Gabriel, 1937.)

t°	Gms. per 100 gms. H_2O		t°	Gms. per 100 gms. H_2O	
	NaOH	Na_3PO_4		NaOH	Na_3PO_4
150	0.0	82	250	20.6	5.5
"	8.2	49	"	29.5	5.7
"	20.0	20.6	350	0.0	0.15
250	0.0	8.6	"	8.0	0.44
"	8.2	7.0	"	21.9	2.0
			"	21.3	2.2

These determinations were made in connection with boiler feed-water studies.

Di SODIUM (Hydrogen) PHOSPHATE $\text{Na}_2\text{HPO}_4 \cdot 12\text{H}_2\text{O}$.

SOLUBILITY OF DISODIUM HYDROGEN PHOSPHATE IN WATER.
(Hammick, Goadby and Booth, 1920.)

Constant agitation in a thermostat was employed. The authors desired to correct some of the points reported by others.

t°.	Gms. Na_2HPO_4 per 100 gms. sat. sol.	Solid Phase.	t°.	Gms. Na_2HPO_4 per 100 gms. sat. sol.	Solid Phase.
-0.47 eutec.	1.45	Ice + $\text{Na}_2\text{HPO}_4 \cdot 12\text{H}_2\text{O}$	29.5....	17.18	$\text{Na}_2\text{HPO}_4 \cdot 12\text{H}_2\text{O}$
+6.0.....	2.73	$\text{Na}_2\text{HPO}_4 \cdot 12\text{H}_2\text{O}$	30.1....	19.45	+ $\beta \text{Na}_2\text{HPO}_4 \cdot 12\text{H}_2\text{O}$
19.95.....	7.26	"	30.9....	20.08	"
22.77.....	8.93	"	32.50....	22.57	"
24.15.....	9.53	"	33.70....	24.63	"
25.75.....	10.90	"	34.70....	29.75	"
27.80.....	14.16	"	35.0....	—	+ $\text{Na}_2\text{HPO}_4 \cdot 7\text{H}_2\text{O}$
28.65.....	15.87	"	36.5....	31.15	$\text{Na}_2\text{HPO}_4 \cdot 7\text{H}_2\text{O}$
29.65.....	16.04	"	40.02....	35.56	"

Data showing the effect of sodium chloride upon the transition temperatures of disodium phosphate hydrate are given by Okazawa, 1920.

SOLUBILITY OF DISODIUM HYDROGEN PHOSPHATE IN WATER.
(Menzel and Gähler, 1929.)

t°	Gms. Na_2HPO_4 per 100:			Solid Phase
	cc sat. sol.	gms. sat. sol.	gms. H_2O	
-0.48	—	—	1.55	Ice + $\text{Na}_2\text{HPO}_4 \cdot 12\text{H}_2\text{O}^*$
0	1.637	1.605	1.631	$\text{Na}_2\text{HPO}_4 \cdot 12\text{H}_2\text{O}^*$
18	6.312	5.985	6.367	"
25	11.928	10.829	12.144	"
25	—	10.51 (1)	—	"

* The β modification according to Hammick, Goodby and Booth.
(1) Palitzsch, S, 1929.

SOLUBILITY OF DISODIUM HYDROGEN PHOSPHATE IN
AQUEOUS SOLUTIONS OF HYDROGEN PEROXIDE AT 0°.
(Menzel and Gähler, 1929.)

Gms. per 100 gms. sat. sol.		Gms. per 100 gms. sat. sol.	
H_2O_2	Na_2HPO_4	H_2O_2	Na_2HPO_4
0.00	1.605	0.9349	1.789
0.2501	1.652	1.288	1.860
0.7132	1.742	1.633	1.923

SOLUBILITY OF DI SODIUM PHOSPHATE IN AQUEOUS SOLUTIONS OF URETHAN AT 25°.
(Palitzsch, 1928, 1929.)

Gm. Mols. per 1000 gms. H_2O		Solid Phase
Na_2HPO_4	$\text{NH}_2\text{COOC}_2\text{H}_5$	
0.54	1.152	$\text{Na}_2\text{HPO}_4 \cdot 12\text{H}_2\text{O}$
0.374	3.62	"

SODIUM Hydrogen **PHOSPHATE** $\text{Na}_2\text{HPO}_4 \cdot 12\text{H}_2\text{O}$.

SOLUBILITY IN WATER.

(Shiomi, 1908; Menzies and Humphrey, 1912.)

t°.	Gms. Na ₂ HPO ₄ per 100 Gms. H ₂ O.	Solid Phase.	t°.	Gms. Na ₂ HPO ₄ per 100 Gms. H ₂ O.	Solid Phase.
— 0.43	1.42	Ice	45	67.3	Na ₂ HPO ₄ ·7H ₂ O
— 0.24	0.70	"	47.23	76.58 (S)	"
— 0.5 Eutec.	...	" + Na ₂ HPO ₄ ·12H ₂ O	48.3 tr. pt.	...	{ Na ₂ HPO ₄ ·7H ₂ O +
+ 0.05	1.67	Na ₂ HPO ₄ ·12H ₂ O	48 "	... (S)	{ Na ₂ HPO ₄ ·2H ₂ O
10.26	3.55 (S)	"	50	80.2	Na ₂ HPO ₄ ·2H ₂ O
15.11	5.23 (S)	"	55.17	81.4 (S)	"
20	7.66	"	60	82.9	"
25	12	"	70.26	88.11 (S)	"
30.21	20.81 (S)	"	80	92.4	"
30.76	23.41 (S)	"	89.74	102.87 (S)	"
32	25.7	"	90.2	101.1	"
33.04	30.88 (S)	"	95 tr. pt.	...	" + Na ₂ HPO ₄
34	33.8	"	95.2 "	... (S)	" "
35.2 tr. pt.	...	" + Na ₂ HPO ₄ ·7H ₂ O	96.2	104.6	Na ₂ HPO ₄
36.45 "	... (S)	" "	99.77	102.15 (S)	"
37.27	47.51 (S)	Na ₂ HPO ₄ ·7H ₂ O	105	103.3	"
39.2	51.8	"	120	90.2	"

Results marked (S) by Shiomi, all others by Menzies and Humphrey.

100 gms. H_2O dissolve 12.2 gms. Na_2HPO_4 at 25° , determined by refractometer.

(Osaka, 1903-8.)

100 gms. H_2O dissolve 5.23 gms. Na_2HPO_4 at 15° , $d_{16} = 1.049$. (Greenish and Smith, 1901.)

100 gms. alcohol of $d_{15} = 0.941$ dissolve 0.33 gm. Na_2HPO_4 at 15.5° .

Mono **SODIUM** (Dihydrogen) **PHOSPHATE** $\text{NaH}_2\text{PO}_4 \cdot 2\text{H}_2\text{O}$.

SOLUBILITY OF MONO SODIUM PHOSPHATE IN WATER. (Apfel, 1911.)

Constant stirring was employed. The solid phases were identified by determinations of their water of crystallization.

t°.	Mols. PO ₄ per 1000 gms. sat. sol.	Gms. NaH ₂ PO ₄ per 100 gms. sat. sol.	Solid Phase,
0.....	3.01	36.1	NaH ₂ PO ₄ · 2H ₂ O
18.....	3.82	45.8	»
25.....	4.05	48.6	»
35.5.....	4.47	53.6	»
40.....	4.7	56.4	»
44.....	4.83	58.0	»
44.....	5.06	60.7	NaH ₂ PO ₄ · H ₂ O (unstable)
50.....	5.15	61.8	NaH ₂ PO ₄ · 2H ₂ O
55.....	5.32	63.8	NaH ₂ PO ₄ · H ₂ O
58.....	5.46	65.5	»
61.....	5.48	65.8	NaH ₂ PO ₄
65.....	5.49	65.9	»
70.....	5.52	66.2	»
75.....	5.60	67.2	»
83.....	5.76	69.1	»

100 gms. sat. sol. of mono sodium phosphate in water contain 48.69 gms. NaH_2PO_4 at 25°. (Schnellbach and Rosin, 1931.)

SOLUBILITY OF MONO SODIUM PHOSPHATE IN AQUEOUS SOLUTIONS
OF SODIUM SULFATE AT 25°. (Apfel, 1911.)

Mols. per 1000 gms. sat. sol.		Gms. per 100 gms. sat. sol.		
PO ₄ .	SO ₄ .	NaH ₂ PO ₄ .	Na ₂ SO ₄ .	Solid Phase.
4.05	0.0	48.6	0.0	Na H ₂ PO ₄ · 2 H ₂ O
3.92	0.11	47.0	1.56	"
3.82	0.26	45.8	3.69	"
3.58	0.45	43.0	6.39	"
3.28	0.71	39.3	10.1	"

SODIUM Dihydrogen **PHOSPHATE** NaH_2PO_4 .

SOLUBILITY IN WATER.

(Imadsu, 1911-12.)

t°.	Gms. NaH_2PO_4 per 100 Gms. H_2O .	Solid Phase.	t°.	Gms. NaH_2PO_4 per 100 Gms. H_2O .	Solid Phase.
0.1	57.86	$\text{NaH}_2\text{PO}_4 \cdot 2\text{H}_2\text{O}$	45	148.20	$\text{NaH}_2\text{PO}_4 \cdot \text{H}_2\text{O}$
5	63.82	"	50	158.61	"
10	69.87	"	55	170.85	"
15	76.72	"	57	175.81	"
20	85.21	"	57.4 tr. pt.	...	" + NaH_2PO_4
25	94.63	"	60	179.33	NaH_2PO_4
30	106.45	"	65	184.99	"
35	120.44	"	69	190.24	"
40	138.16	"	80	207.29	"
40.8 tr. pt.	...	" + $\text{NaH}_2\text{PO}_4 \cdot \text{H}_2\text{O}$	90	225.31	"
41	142.55	$\text{NaH}_2\text{PO}_4 \cdot \text{H}_2\text{O}$	99.1	246.56	"

SODIUM Acid **PHOSPHATE** $\text{NaH}_2\text{PO}_4 \cdot \text{H}_3\text{PO}_4$.

SOLUBILITY IN WATER AND IN ANHYDROUS PHOSPHORIC ACID, DETERMINED BY THE SYNTHETIC METHOD.

(Parravano and Mieli, 1908.)

Solubility in Water.

Solubility in H_3PO_4 .

t°.	Gms. NaH_2PO_4 H_3PO_4 per 100 Gms. Sat. Sol.	Solid Phase.	t°.	Gms. NaH_2PO_4 H_3PO_4 per 100 Gms. Sat. Sol.	Solid Phase.	t°.	Gms. NaH_2PO_4 H_3PO_4 per 100 Gms. Sat. Sol.
-5.7	20.77	Ice	79.7	87.48	NaH_2PO_4	98.5	52.72
-7.9	26.92	"	85	88.65	"	111	69.59
-11.4	34.15	"	101.7	91.47	" + $\text{NaH}_2\text{PO}_4 \cdot \text{H}_3\text{PO}_4$	119	77.55
-38	56.66	"	104.5	92.67	$\text{NaH}_2\text{PO}_4 \cdot \text{H}_3\text{PO}_4$	122	81.71
-34	80.46	NaH_2PO_4	110	95.79	"	123	87.20
41	81.82	"	119	97.99	"		
51.7	83.68	"	126.5	100	" m. pt. of the $\text{H}_3\text{PO}_4 = 40.6^\circ$		

Data are also given for the fusion points of $\text{NaH}_2\text{PO}_4 + \text{H}_3\text{PO}_4$.Fusion-point data for mixtures of $\text{NaPO}_3 + \text{Na}_4\text{P}_2\text{O}_7$ are given by Parravano and Calcagni (1908, 1910.)EQUILIBRIUM IN THE SYSTEM SODIUM HYDROXIDE, PHOSPHORIC ACID AND WATER AT 25° .

(D'Ans and Schreiner, 1910a.)

Mols. per 1000 Gms. Sol.		Solid Phase.	Mols. per 1000 Gms. Sol.		Solid Phase.
Na.	PO_4 .		Na.	PO_4 .	
13.32	...	$\text{NaOH} \cdot \text{H}_2\text{O}$	6.76	4.88	$\text{Na}_2\text{HPO}_4 \cdot 7\text{H}_2\text{O}$
4.28	0.040	$\text{Na}_3\text{PO}_4 \cdot 12\text{H}_2\text{O}$	7.31	5.55	" unstable
3.24	0.183	"	6.76	4.88	" + $\text{Na}_2\text{HPO}_4 \cdot 2\text{H}_2\text{O}$
2.24	0.752	"	6.19	4.68	$\text{Na}_2\text{HPO}_4 \cdot 2\text{H}_2\text{O}$
2.73	1.08	"	6.01	4.67	"
3.48	1.33	$\text{Na}_2\text{PO}_4 \cdot 12\text{H}_2\text{O} + \text{Na}_2\text{HPO}_4 \cdot 12\text{H}_2\text{O}$	5.12	4.36	"
2.62	1.09	$\text{Na}_2\text{HPO}_4 \cdot 12\text{H}_2\text{O}$	4.81	4.22	"
1.56	0.78	"	4.36	4.08	"
2.38	1.60	"	4.06	4.03	"
3.18	2.24	"	4.19	4.38	"
4.65	3.55	"	4.32	4.96	"
5.63	3.87	"	4.65	5.89	"
6.31	4.63	$\text{Na}_2\text{HPO}_4 \cdot 7\text{H}_2\text{O}$	4.88	6.40	"

SODIUM Hypo PHOSPHATES $\text{Na}_4(\text{PO}_3)_2 \cdot 10 \text{H}_2\text{O}$, $\text{Na}_3\text{H}(\text{PO}_3)_2 \cdot 9 \text{H}_2\text{O}$,
 $\text{Na}_2\text{H}_2(\text{PO}_3)_2 \cdot 6 \text{H}_2\text{O}$.

EQUILIBRIUM IN THE SYSTEM SODIUM OXIDE, PHOSPHORUS TETROXIDE AND WATER
 AT 30°. (Müller, 1916.)

Saturation was secured by constant agitation in a thermostat. The author's determinations were plotted and the following results were read from the diagram.

Gms. per 100 gms. sat. sol.			Gmg. per 100 gms. sat. sol.			Gms. per 100 gms. sat. sol.		
Na_2O .	P_2O_5 .	Solid Phase.	Na_2O .	P_2O_5 .	Solid Phase.	Na_2O .	P_2O_5 .	Solid Phase.
0.83	0.84	Na_4	0.75	1.53	Na_2	0.75	1.53	Na_2
1.00	1.12	γ	1.0	1.75	x	0.80	1.85	
1.2	1.40	γ	1.2	1.97	x	0.90	2.55	
1.4	1.67	γ	1.4	2.20	x	1.00	3.16	
1.6	1.97	γ	1.6	2.44	x	1.10	3.85	
1.8	2.28	γ	1.8	2.65	x	1.20	4.50	
2.0	2.56	γ	2.0	2.90	x	1.30	5.25	
2.2	2.85	γ	2.2	3.15	x	1.40	5.90	
2.35	3.07	Na_3	2.35	3.38	Na_3	1.47	6.57	

$\text{Na}_4 = \text{Na}_4(\text{PO}_3)_2 \cdot 10 \text{H}_2\text{O}$; $\text{Na}_3 = \text{Na}_3\text{H}(\text{PO}_3)_2 \cdot 9 \text{H}_2\text{O}$; $\text{Na}_2 = \text{Na}_2\text{H}_2(\text{PO}_3)_2 \cdot 6 \text{H}_2\text{O}$.

The author was unable to identify the solid phases corresponding to the three branches of the solubility diagram of this system.

SOLUBILITY OF SODIUM HYPHOSPHATE, SODIUM HYDROGEN HYPHOSPHATE
 AND OF SODIUM DIHYDROGEN HYPHOSPHATE, EACH SEPARATELY, IN WATER.
 (Müller, 1916.)

Sodium Hypophosphate $\text{Na}_2\text{PO}_3 \cdot 5 \text{H}_2\text{O}$.			Sodium Hydrogen Hypophosphate $\text{Na}_3\text{H}(\text{PO}_3)_2 \cdot 9 \text{H}_2\text{O}$.			Sodium Dihydrogen Hypophosphate $\text{NaHPO}_3 \cdot 5 \text{H}_2\text{O}$.			PO
t° .	Gms. Na_2PO_3 per 100 gms. sat. sol.		t° .	Gms. $\text{Na}_3\text{H}(\text{PO}_3)_2$ per 100 gms. sat. sol.		t° .	Gms. NaHPO_3 per 100 gms. sat. sol.		
25.2.....	1.47		25.....	4.46		25.....	1.95		
30.....	1.68		30.2.....	5.55		30.....	2.50		
35.....	1.91		35.2.....	6.68		35.....	2.99		
40.2.....	2.24		40.....	8.30		40.....	3.66		
45.....	2.64		45.....	10.60		45.....	4.55		
50.....	3.08		50.....	13.02		50.....	5.61		

SODIUM PyroPHOSPHATE $\text{Na}_4\text{P}_2\text{O}_7 \cdot 10 \text{H}_2\text{O}$.

SOLUBILITY IN WATER.
 (Mulder; Poggiale.)

t° .	Gms. per 100 Gms. H_2O .	t° .	Gms. per 100 Gms. H_2O .	t° .	Gms. per 100 Gms. H_2O .
0	3.16	25	8.14	60	21.83
10	3.95	30	9.95	80	30.04
20	6.23	40	13.50	100	40.26
		50	17.45		

SODIUM PyroPHOSPHATES.

SOLUBILITY IN WATER.
 (Giran, 1903a.)

Salt.	Formula.	t° .	Gms. Anhydrous Salt per 100 cc. Sat. Sol.
Monosodium Pyrophosphate	$\text{NaH}_2\text{P}_2\text{O}_7$	18	62.7
Disodium Pyrophosphate	$\text{Na}_2\text{H}_2\text{P}_2\text{O}_7 \cdot 6 \text{H}_2\text{O}$	18	14.95
Trisodium Pyrophosphate	$\text{Na}_3\text{HP}_2\text{O}_7 \cdot 6 \text{H}_2\text{O}$	18	28.17

SOLUBILITY OF SODIUM PYRO PHOSPHATE IN WATER.

(Menzel and G bler, 1929; Menzel and Sieg, 1932.)

t ^o	Gms. Na ₄ P ₂ O ₇ per 100 gms. sat. sol.	Solid Phase	t ^o	Gms. Na ₄ P ₂ O ₇ per 100 gms. sat. sol.	Solid Phase
-0.43	2.132	Ice+Na ₄ P ₂ O ₇ ·10H ₂ O	60	19.75	Na ₄ P ₂ O ₇ ·10H ₂ O
0	2.236	Na ₄ P ₂ O ₇ ·10H ₂ O	70	27.49	
18	5.147	"	76	33.04	"
20	5.220	"	79.5	tr.pt.	—
25	6.618	"	82	35.13	Na ₄ P ₂ O ₇ + Na ₄ P ₂ O ₇
30	7.04	"	89	32.65	"
45	11.61	"	96	31.15	"
50	13.98	"			

SOLUBILITY OF SODIUM PYRO PHOSPHATE IN AQUEOUS SOLUTIONS
OF HYDROGEN PEROXIDE AT 0^o.

(Menzel and G bler, 1929.)

PO

Gms. per 100 gms. sat. sol.		Gms. per 100 gms. sat. sol.	
H ₂ O ₂	Na ₄ P ₂ O ₇	H ₂ O ₂	Na ₄ P ₂ O ₇
0.5107	2.460	1.345	2.980
0.5795	2.506	2.082	3.475
0.9430	2.710	2.440	3.766

Di SODIUM Di Hydrogen Pyro PHOSPHATE Na₂H₂P₂O₇·6H₂O.

SOLUBILITY OF DISODIUM PYRO PHOSPHATE IN WATER.

(Selva, 1935.)

t ^o	d. of sat. sol.	Gms. Na ₂ H ₂ P ₂ O ₇ per 100 gms. sat. sol.	Solid Phase	t ^o	d. of sat. sol.	Gms. Na ₂ H ₂ P ₂ O ₇ per 100 gms. sat. sol.	Solid Phase
-0.7	—	4.08	Ice+Na ₂ H ₂ P ₂ O ₇ ·6H ₂ O	30	1.1312	16.48	*Na ₂ H ₂ P ₂ O ₇ ·6H ₂ O
0	—	4.28	Na ₂ H ₂ P ₂ O ₇ ·6H ₂ O	27	1.1156	14.35	"Na ₂ H ₂ P ₂ O ₇ ·6H ₂ O
10	1.0509	6.50	"	30	—	14.58	Na ₂ H ₂ P ₂ O ₇
20	1.0847	10.70	"	35	1.1171	15.04	"
25	1.1040	13.00	"	40	1.1180	15.52	"

* Metastable

EQUILIBRIUM IN THE SYSTEM TETRA SODIUM PYRO PHOSPHATE,
DISODIUM PYRO PHOSPHATE AND WATER.
(Selva, 1935.)

Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase
$\text{Na}_4\text{P}_2\text{O}_7$	$\text{Na}_2\text{H}_2\text{P}_2\text{O}_7$		$\text{Na}_4\text{P}_2\text{O}_7$	$\text{Na}_2\text{H}_2\text{P}_2\text{O}_7$	
Results at 20°			Results at 20° (con.)		
5.25	0.00	$\text{Na}_4.10$	5.61	12.8	$\text{Na}_2.6$
7.18	3.01	"	0.0	10.70	"
9.43	6.80	"	Results at 30°		
11.66	10.31	"			
15.45	16.22*	"	7.35	0.0	$\text{Na}_4.10$
12.55	11.58	" + $\text{Na}_3.7$	12.82	9.30	" + $\text{Na}_3.1$
11.90	12.67	$\text{Na}_3.7$	11.47	10.37	$\text{Na}_3.1$
11.58	13.74	"	10.62	13.25	"
11.07	16.55	" + $\text{Na}_2.6$	9.72	18.30	" + $\text{Na}_2\text{H}_2\text{P}_2\text{O}_7$
8.26	14.51	$\text{Na}_2.6$	0.0	14.50	$\text{Na}_2\text{H}_2\text{P}_2\text{O}_7$

PO

* = Metastable

$\text{Na}_4.10 = \text{Na}_4\text{P}_2\text{O}_7 \cdot 10\text{H}_2\text{O}$; $\text{Na}_3.7 = \text{Na}_3\text{H}_2\text{P}_2\text{O}_7 \cdot 7\text{H}_2\text{O}$; $\text{Na}_2.6 = \text{Na}_2\text{H}_2\text{P}_2\text{O}_7 \cdot 6\text{H}_2\text{O}$
 $\text{Na}_3.1 = \text{Na}_2\text{HP}_2\text{O}_7 \cdot 1\text{H}_2\text{O}$.

SODIUM Methyl PHOSPHATE (neutral) $\text{Na}_2\text{CH}_2\text{PO}_4 \cdot 6\text{H}_2\text{O}$.

100 gms. sat. solution of neutral sodium methyl phosphate in water contain 30.79 gms. of the anhydrous salt at 12°5. (Bailly, 1919.)

SODIUM β Glycero PHOSPHATE $\text{Na}_2\text{C}_3\text{H}_5(\text{OH})_2\text{PO}_4 \cdot 5\text{H}_2\text{O}$.

100 gms. sat. solution of sodium β glycerophosphate in water contain 27.16 gms. of the anhydrous compound at 17°. (Bailly, 1916.)

100 gms. H_2O dissolve 27.38 gms. sodium glycerophosphate at 18°.

(H. Rogier, *These*, Paris, 1912.)

100 gms. 86.5 % Glycerol ($d = 1.2326$) dissolve 79.7 gms. of sodium glycerophosphate (?hydrated) at 20°.

100 gms. 98.5 % Glycerol ($d = 1.2645$) dissolve 82.4 gms. of sodium glycerophosphate (?hydrated) at 20°. (Holm, 1921, 1922.)

SODIUM Per RHENATE NaReO_4 .

ReO

A sat. solution of Sodium Per Rhenate in Water contains about 250 gms. NaReO_4 per liter at 20°(?). (Noddak and Noddak, 1929.)

SOLUBILITY OF SODIUM PER RHENATE IN ETHYL ALCOHOL.

(Tollert, 1932.)

Solvent	t°	Gms. NaReO_4 per liter sat. sol.
89.7 Wt. % $\text{C}_2\text{H}_5\text{OH}$	19.5	22.42
99.1 " "	18.0	11.14

SODIUM SULFIDE $\text{Na}_2\text{S} \cdot 9\text{H}_2\text{O}$.

SOLUBILITY IN WATER.

(Parravano and Fornaini, 1907.)

t°.	Gms. Na_2S per 100 Gms. Sat. Sol.	Solid Phase.	t°.	Gms. Na_2S per 100 Gms. Sat. Sol.	Solid Phase.
-10 Eutec.	9.34	$\text{Na}_2\text{S} \cdot 9\text{H}_2\text{O} + \text{Ice}$	60	29.92	$\text{Na}_2\text{S} \cdot 5\frac{1}{2}\text{H}_2\text{O}$
+10	13.36	$\text{Na}_2\text{S} \cdot 9\text{H}_2\text{O}$	70	31.38	"
15	14.36	"	80	33.95	"
18	15.30	"	90	37.20	"
22	16.20	"	48 tr. pt.	...	$\text{Na}_2\text{S} \cdot 9\text{H}_2\text{O} + \text{Na}_2\text{S} \cdot 6\text{H}_2\text{O}$
28	17.73	"	50	26.7	$\text{Na}_2\text{S} \cdot 6\text{H}_2\text{O}$
32	19.09	"	60	28.1	"
37	20.98	"	70	30.22	"
45	24.19	"	80	32.95	"
48.9 tr. pt.	...	" $+ \text{Na}_2\text{S} \cdot 5\frac{1}{2}\text{H}_2\text{O}$	90	36.42	"
50	28.48	$\text{Na}_2\text{S} \cdot 5\frac{1}{2}\text{H}_2\text{O}$	91.5 tr. pt.	...	" $+ \text{Na}_2\text{S} \cdot 5\frac{1}{2}\text{H}_2\text{O}$

SOLUBILITY OF SODIUM SULFIDE IN WATER, DETERMINED BY THE FREEZING-POINT METHOD. (Sanfourche and Liebaut, 1922.)

The authors results were plotted and the following table constructed from the curves.

t°.	Gms. Na_2S per 100 gms. sat. sol.	Solid Phase.	t°.	Gms. Na_2S per 100 gms. sat. sol.	Solid Phase.
-2.0	2.0	Ice	50 tr. pt.	28.0	$\text{Na}_2\text{S} \cdot 9\text{H}_2\text{O} + \text{Na}_2\text{S} \cdot 5\frac{1}{2}\text{H}_2\text{O}$
-5.0	5.0	"	70	32.5	$\text{Na}_2\text{S} \cdot 5\frac{1}{2}\text{H}_2\text{O}$
-9.5 Eutec.	7.5	" $+ \text{Na}_2\text{S} \cdot 9\text{H}_2\text{O}$	90	39.5	"
0	8.8	$\text{Na}_2\text{S} \cdot 9\text{H}_2\text{O}$	97.5 m. pt.	45.0	"
10	10.8	"	90	52.5	"
20	13.6	"	86 Eutec.	54.5	" $+ \text{Na}_2\text{S} \cdot \text{H}_2\text{O}$
30	17.0	"	90	57.8	$\text{Na}_2\text{S} \cdot \text{H}_2\text{O}$
40	21.0	"	95	60.1	"

EQUILIBRIUM IN THE SYSTEM SODIUM SULFATE, SODIUM SULFIDE AND WATER. (Hogg, 1926.)

The attainment of equilibrium was effected by (1) cooling homogeneous solutions from higher temperatures and, when necessary, innoculating with the appropriate solid phase (systems at 0° and 18°), (2) heating heterogeneous systems from lower temperatures (systems at 25° and 31°) (3) evaporating homogeneous solutions under reduced pressure at the temperature of the experiment (40°) until sufficient solid appeared. When all phases were present the tubes were mechanically rotated in a thermostat for from 4 to 40 hours. The saturated solutions and moist solid phases were analyzed. M. C. with formula, indicates mixed crystals and the major constituent.

Results at 0°.4.

d _{0.1} of sat. sol.	Gms. per 100 gms. sat. sol.		Solid Phase.	d _{0.1} of sat. sol.	Gms. per 100 gms. sat. sol.		Solid Phase.
	Na_2SO_4	Na_2S			Na_2SO_4	Na_2S	
1.041	2.99	1.44	M.C. $\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}$	1.129	1.23	11.18	M.C. $\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}$ $+ \text{M.C. Na}_2\text{S} \cdot 10\text{H}_2\text{O}$
1.052	2.11	3.16	"	1.129	1.16	11.16	" "
1.066	1.68	4.79	"	1.131	1.19	11.23	" "
1.081	1.54	6.16	"	1.130	1.25	11.14	" "
1.091	1.48	7.36	"	1.131	1.23	11.21	" "
1.099	1.28	8.32	"	1.137	1.16	11.94	M.C. $\text{Na}_2\text{S} \cdot 10\text{H}_2\text{O}$
1.110	1.27	9.49	"	-	0.93	11.22	"
1.124	1.24	10.77	"	1.125	0.63	11.34	"
1.129	1.19	11.11	"	1.122	0.0	11.33	"
1.132	1.18	11.23	M.C. $\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}$ $+ \text{M.C. Na}_2\text{S} \cdot 10\text{H}_2\text{O}$				

EQUILIBRIUM IN THE SYSTEM SODIUM SULFATE, SODIUM SULFIDE AND WATER (CON.)
(Hogg, 1926.)

(Hogg, 1926.)

d of sat. sol.	Gms. per 100 gms. sat. sol.		Solid Phase.	d of sat. sol.	Gms. per 100 gms. sat. sol.		Solid Phase.
	Na ₂ SO ₄ .	Na ₂ S.			Na ₂ SO ₄ .	Na ₂ S.	
Results at 18°.				Results at 31°.			
1.126	13.31	0.62	Na ₂ SO ₄ .10 H ₂ O	1.285	29.97	0.40	Na ₂ SO ₄ .10 H ₂ O
1.126	11.91	1.51	"	1.294	29.15	1.47	"
1.131	10.67	2.84	"	1.291	28.72	2.43	"
1.130	9.30	4.54	"	1.290	28.65	2.31	" + Na ₂ SO ₄
1.132	9.05	5.33	"	1.288	27.39	2.85	" "
1.143	8.09	6.82	"	1.264	23.06	4.81	Na ₂ SO ₄
1.149	7.64	7.99	"	1.248	19.47	6.97	"
1.162	7.15	9.47	"		18.92	7.47	"
1.165	9.96	7.09	"	1.228	14.46	9.83	"
1.167	7.17	10.04	"	1.219	11.56	12.14	"
1.175	6.96	10.91	"	1.214	8.59	14.39	"
1.186	6.93	12.14	"		6.58	16.36	"
1.208	7.01	13.08	"	1.214	4.79	18.69	"
1.225	9.75	13.15	"	1.253	2.56	22.22	"
1.210	7.24	13.95	" + M.C.Na ₂ S.9 H ₂ O	1.222	4.32	19.69	" + Na ₂ S.9 H ₂ O
1.212	7.21	13.90	" "	1.229	4.04	19.33	" "
-	6.44	13.98	M.C.Na ₂ S.9 H ₂ O	-	3.04	19.57	Na ₂ S.9 H ₂ O
1.212	5.83	14.02	"	1.210	1.05	20.44	"
1.197	5.20	14.50	"	1.202	0.0	20.60	"
1.187	3.47	15.08	"	Results at 40°			
-	2.28	15.33	"	1.302	28.90	1.32	Na ₂ SO ₄
-	0.53	15.65	"	-	24.43	3.56	"
1.169	-	15.95	Na ₂ S.9 H ₂ O	1.260	20.25	6.18	"
Results at 25°				-	15.23	9.49	"
-	19.71	1.63	Na ₂ SO ₄ .10 H ₂ O	1.236	14.14	9.78	"
1.203	17.84	3.27	"	1.223	8.72	14.25	"
1.204	17.12	4.40	"	-	7.37	14.97	"
1.241	14.67	9.96	" + Na ₂ SO ₄	1.223	6.53	15.45	"
1.241	14.70	9.96	" "	-	5.22	14.08	"
1.241	14.51	10.04	Na ₂ SO ₄	1.233	3.41	20.36	"
1.237	12.50	11.21	"	1.239	2.79	21.27	"
1.222	10.80	12.68	"	1.223	1.91	23.04	"
1.228	8.06	14.68	"	1.253	1.84	23.57	"
1.221	6.32	16.07	" + Na ₂ S.9 H ₂ O	1.248	1.90	23.72	" + Na ₂ S.9 H ₂ O
1.224	6.87	15.87	" "	1.256	1.62	24.25	" "
1.229	7.18	15.84	" "	1.238	0.88	23.93	Na ₂ S.9 H ₂ O
1.205	5.01	16.61	Na ₂ S.9 H ₂ O	1.236	0.49	24.06	"
1.202	3.40	17.17	"	1.248	0.0	25.01	"
1.183	0.0	17.86	"	1.248	0.0	25.09	"

S

The following transition points were also determined.

Binary..	Transition.	t°.	d of 3 sat. sol.	Gms. per 100 gms. sat. sol.	
				Na ₂ SO ₄ .	Na ₂ S.
Binary..	Na ₂ S.10 H ₂ O \rightleftharpoons Na ₂ S.9 H ₂ O.....	4.7..	1.128	-	12.46
Ternary.	The above in sat. Na ₂ SO ₄	2.3..	1.135	1.40	11.49
"	Na ₂ SO ₄ .10 H ₂ O \rightleftharpoons Na ₂ SO ₄ in sat. Na ₂ S.	20.9..	-	9.48	13.41
"	?	.....	1.331	4.48	19.97

In all cases the densities were measured at the temperature of the experiment.

SODIUM SULFIDE

SOLUBILITY OF SODIUM SULFIDE IN LIQUID AMMONIA
CONTAINING INCREASING AMOUNTS OF AMMONIUM BROMIDE AT -33° .
(Johnson and Wheatley, 1934.)

Gm. Mols. per liter sat. sol.	
NH_4Br	Na_2S
0.0	0.002
0.15	0.036
0.3	0.06
0.6	0.18

This increase in solubility of Na_2S is considered to be due to the formation of ammonium sulfide.

Fusion-point data are given for:

$\text{Na}_2\text{S} + \text{S}$ (Friedrich, 1914; Thomas and Rule, 1917; Pearson and Robinson, 1930.)
 $\text{Na}_2\text{S} + \text{Na}_2\text{SO}_4$ (Tammann and Olsen, 1930.)

SO SODIUM SULFITE $\text{Na}_2\text{SO}_3 \cdot 7\text{H}_2\text{O}$.

SOLUBILITY OF SODIUM SULFITE IN WATER.
(Foerster, Brosch and Norberg-Schulz, 1924.)

The determinations were made with exceptional care. The solutions were kept in contact with an atmosphere of hydrogen to prevent oxidation.

t°.	Gms. Na_2SO_3 per 100 gms. sat. sol.	Solid Phase.	t°.	Gms. Na_2SO_3 per 100 gms. sat. sol.	Solid Phase.
— 0.667	1.865	Ice	33.8	28.54 (unstable)	$\text{Na}_2\text{SO}_3 \cdot 7\text{H}_2\text{O}$
— 1.27	3.73	»	34.7	28.86	»
— 2.23	6.69	»	35.9	29.89	»
— 2.70	8.12	»	34.5	28.20	Na_2SO_3
— 3.45 Rec. ..	10.48	» + $\text{Na}_2\text{SO}_3 \cdot 7\text{H}_2\text{O}$	35.6	27.80	»
— 1.30	11.25	$\text{Na}_2\text{SO}_3 \cdot 7\text{H}_2\text{O}$	41.0	27.15	»
0.0	12.59	»	46.0	26.35	»
9.2	15.60	»	50.0	25.75	»
16.5	19.14	»	58.1	24.79	»
19.9	20.82	»	66.0	24.06	»
24.0	22.76	»	70.0	23.85	»
26.85	24.32	»	94.4	21.44	»
28.2	25.36	»	97.0	21.32	»
33.0	27.99	»	99.0	21.70	»
33.4 tr. pt.	—	» + Na_2SO_3			

The above results show that the transition temperature of $21^{\circ}.6$ for $\text{Na}_2\text{SO}_3 \cdot 7\text{H}_2\text{O} \rightleftharpoons \text{Na}_2\text{SO}_3$ and the solubilities of Na_2SO_3 , reported by Hartley and Barrett, 1909, are incorrect.

The density of the sat. sol. at 15° is 1.21. (Greenish and Smith, 1901.)

SODIUM SULFITE Na_2SO_3 .

The following results for the solubility of sodium sulfite in water are by Arai, 1932.

t°	Gms. Na_2SO_3 per 100 gms. sat. sol.	Solid Phase
25	23.05	$\text{Na}_2\text{SO}_3 \cdot 7\text{H}_2\text{O}$
35	26.57	Na_2SO_3

This author also gives results for the System $\text{Na}_2\text{SO}_3 + \text{Na}_2\text{S}_2\text{O}_5 + \text{H}_2\text{O}$ at 25° and at 35° .

SOLUBILITY OF SODIUM SULFITE IN WATER.

(Hartley and Barrett, 1909.)

t°	Gms. Na_2SO_3 per 100 Gms. H_2O	Solid Phase.	t°	Gms. Na_2SO_3 per 100 Gms. H_2O	Solid Phase.
- 0.76	2.15	Ice	18.2	25.31	$\text{Na}_2\text{SO}_3 \cdot 7\text{H}_2\text{O}$
- 1.37	4.21	"	23.5	29.92	" (unstable)
- 1.96	6.24	"	29	34.99	" "
- 2.77	9.44	"	37.2	44.08	" "
- 3.5*	12.48	" + $\text{Na}_2\text{SO}_3 \cdot 7\text{H}_2\text{O}$	21.6†	...	" + Na_2SO_3
- 4.5	17.91	Ice (unstable)	37	28.04	Na_2SO_3
- 1.9	13.09	$\text{Na}_2\text{SO}_3 \cdot 7\text{H}_2\text{O}$	47	28.13	"
+ 2	14.82	"	55.6	28.21	"
- 5.9	17.61	"	59.8	28.76	"
10.6	20.01	"	84	28.26	"

* Eutec.

† tr. pt.

See the following discussion by Rivett and Lewis, 1923.

EQUILIBRIUM IN THE SYSTEM SODIUM SULFITE, SODIUM SULFATE AND WATER.
(Rivett and Lewis, 1923.)

Constant agitation was employed for assuring saturation. The solutions and solid phases were analyzed and the compositions of the latter identified by the « rest method ». At 25° both a stable and a metastable system exists, and each was determined. The solid phases in contact with the solutions corresponding to the two branches of the stable system were respectively a series of mixed crystals of $\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O} + \text{Na}_2\text{SO}_3 \cdot 10\text{H}_2\text{O}$ and $\text{Na}_2\text{SO}_4 \cdot 7\text{H}_2\text{O} + \text{Na}_2\text{SO}_3 \cdot 7\text{H}_2\text{O}$. The solid phases for the two branches of the metastable system were mixed crystals of anhydrous sulfite and sulfate.

Results at 25° for the
Stable System.

$d_{25}^{\frac{25}{4}}$ of sat. sol.	Gms. per 100 gms. sat. sol.	
	Na_2SO_4	Na_2SO_3
1.211...	20.40	2.53
1.227...	19.66	4.11
1.239...	18.11	6.59
1.258...	17.31	9.22
1.269...	16.43	11.39
1.292...	15.25	14.61
1.311...	14.55	16.80
1.312...	14.49	16.81
- ...	11.05	18.27
1.274...	8.97	19.44
1.250...	4.14	21.61
- ...	0.00	23.75

Results at 25° for the
Metastable System.

$d_{25}^{\frac{25}{4}}$ of sat. sol.	Gms. per 100 gms. sat. sol.	
	Na_2SO_4	Na_2SO_3
1.347...	20.51	14.39
1.347...	19.12	15.43
1.347...	17.82	16.94
1.347...	16.32	18.34
- ...	16.18	18.52
1.346...	13.82	20.35
- ...	12.34	21.88
1.346...	10.93	23.40
1.340...	7.47	26.32
1.322...	6.75	25.45
1.302...	3.99	26.57
1.285...	1.69	27.29

The authors also determined the isotherms for 0°., 17°., 5 and 37°., 5. At the latter temperature the solid phases were mixed crystals of the anhydrous salts. In subsequent papers by Lewis and Rivett, 1924, data are given for many other isotherms. By extrapolation of these results to zero content of sodium sulfate solubility results for pure sodium sulfite hepta hydrate were obtained. These when plotted together with the determinations of Hartley and Barrett, 1909 (see preceeding page) agreed satisfactorily and give confidence in the extrapolation method of estimating the solubility of sodium sulfite heptahydrate. When, however, the extrapolated values obtained by use of commercial anhydrous sodium sulfite (already containing sulfate), were compared with the results of Hartley and Barrett, determined upon perfectly pure sulfite, a considerable difference was found. Thus, the transition temperature was 31°., 5 at 27.2 per cent concentration of Na_2SO_3 instead of 22° at 22.0 per cent Na_2SO_3 , as found by Hartley and Barrett. The other estimated values for the solubility of anhydrous sodium sulfite were :

t°.....	13.0.	37.5.	42.5.	47.5.	52.5.	57.5.	62.5.	67.5.
Wt. % Na_2SO_3	26.8	26.3	25.7	25.25	24.7	24.1	23.6	23.2

The authors surmised « that the marked discrepancy is due to the mixed crystals of sulfite and sulfate corresponding, in the limiting case of zero sulfate, with a form of sodium sulfite which is metastable to that obtained as a pure salt by Hartley and Barrett's method ». A complete examination of the whole ternary system, at temperatures where only the anhydrous solids appeared, was then made. The results showed that these two salts are capable of mixing in quite a number of distinct series of mixed crystals of varying stabilities. More than 80 solutions were prepared at 40°, 45° and 60° by more or less complicated methods, involving evaporation of unsaturated solutions of suitable concentrations to yield the solid phases in desired quantity at the temperature of the experiment. The analytical results, when plotted, show that there are no fewer than five solution curves and five corresponding series of mixed crystals. The precise limits of these are uncertain « but the error is not sufficient to affect the general conclusions ».

SODIUM HydroSULFITE $\text{Na}_2\text{S}_2\text{O}_4$.

SOLUBILITY IN WATER. (Jellinck, 1911.)

t°.	Gms. $\text{Na}_2\text{S}_2\text{O}_4$ per 100 Gms. H_2O .	Solid Phase.	t°.	Gms. $\text{Na}_2\text{S}_2\text{O}_4$ per 100 Gms. H_2O .	Solid Phase.
-0.107	0.394	Ice	- 4.58 Eutec.	19	Ice + $\text{Na}_2\text{S}_2\text{O}_4 \cdot 2\text{H}_2\text{O}$
-1.10	4	"	+20	22 ($\pm 5\%$ error)	$\text{Na}_2\text{S}_2\text{O}_4 \cdot 2\text{H}_2\text{O}$
-2.21	9	"	52 tr. pt.	27.8	" $\frac{1}{2}\text{Na}_2\text{S}_2\text{O}_4$
-3.15	13	"	20	24.1	$\text{Na}_2\text{S}_2\text{O}_4$ (unstable)
-4.17	17	"			

The pure sample was prepared by salting out the commercial product with NaCl. It is very easily oxidized to $\text{Na}_2\text{S}_2\text{O}_5$ and must be kept in an indifferent atmosphere or a vacuum. A special apparatus was required for the freezing-point determinations (ice curve) and for the solubility determinations. Great difficulty was experienced in obtaining concordant results with a given sample of $\text{Na}_2\text{S}_2\text{O}_4$.

SODIUM PyroSULFITE $\text{Na}_2\text{S}_2\text{O}_5 \cdot 7\text{H}_2\text{O}$, $\text{Na}_2\text{S}_2\text{O}_5 \cdot 6\text{H}_2\text{O}$ (metastable)

SOLUBILITY OF SODIUM PYROSULFITE IN WATER.

(Foerster, Brosch and Norberg-Schulz, 1924.)

SO

The determinations were made with exceptional care. Equilibrium was approached from above and below. A new preparation of the salt was used for each determination and the composition of the solid phase was determined by analysis in each case. In order to reduce the free sulfur dioxide present, the volume of air space above the saturated solution was kept at a minimum. The two hydrates give solubility curves which are almost parallel. The metastable hexahydrate is very easy to obtain and its equilibrium with the solutions can be readily followed.

t°.	Gms. $\text{Na}_2\text{S}_2\text{O}_5$ per 100 gms. sat. sol.	Solid Phase.	t°.	Gms. $\text{Na}_2\text{S}_2\text{O}_5$ per 100 gms. sat. sol.	Solid Phase.
-0.56.....	1.435	Ice	- 7.5.....	24.50	$\text{Na}_2\text{S}_2\text{O}_5 \cdot 7\text{H}_2\text{O}$
-2.28.....	6.40	"	- 5.0.....	26.15	"
-3.19.....	9.00	"	0.0.....	31.10	"
-5.24.....	14.64	"	- 1.2.....	32.45	"
-7.84.....	20.92	"	5.5 tr. pt.	-	" + $\text{Na}_2\text{S}_2\text{O}_5$
-9.74 Eutec.	24.20	$\gamma + \text{Na}_2\text{S}_2\text{O}_5 \cdot 6\text{H}_2\text{O}$	0.0.....	37.47 (unst.)	$\text{Na}_2\text{S}_2\text{O}_5$
-8.5.....	24.75	$\text{Na}_2\text{S}_2\text{O}_5 \cdot 6\text{H}_2\text{O}$	8.6.....	38.65	"
-4.2.....	28.10	"	15.0.....	39.20	"
-2.2.....	30.25	"	22.8.....	39.77	"
0.0.....	32.90	"	31.4.....	40.79	"
+1.8.....	35.40	"	40.2.....	41.60	"
3.0.....	37.10	"	59.0.....	44.27	"
3.8 tr. pt.	-	" + $\text{Na}_2\text{S}_2\text{O}_5$	71.4.....	45.62	"
-9.05 Eutec.	23.50	Ice + $\text{Na}_2\text{S}_2\text{O}_5 \cdot 7\text{H}_2\text{O}$	85.0.....	47.89	"
-9.0.....	23.77	$\text{Na}_2\text{S}_2\text{O}_5 \cdot 7\text{H}_2\text{O}$	97.2.....	49.06	"

SODIUM SULFITE

EQUILIBRIUM IN THE SYSTEM SODIUM SULFITE, SODIUM
PYRO SULFITE AND WATER AT 25° AND AT 35°.
(Arlt, 1927.)

Results at 25°

Results at 35°

Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase
Na_2SO_3	$\text{Na}_2\text{S}_2\text{O}_5$		Na_2SO_3	$\text{Na}_2\text{S}_2\text{O}_5$	
23.05	0.0	$\text{Na}_2\text{SO}_3 \cdot 7\text{H}_2\text{O}$	26.57	0.0	Na_2SO_3
20.98	3.66	"	25.00	2.13	"
17.70	10.39	"	24.17	3.27	"
17.01	12.49	"	21.04	8.00	"
15.67	16.70	"	19.22	11.54	"
15.06	18.65	"	16.60	16.33	"
13.89	21.91	"	14.80	20.40	"
11.83	26.73	"	11.86	25.80	"
11.28	29.10	" + $\text{Na}_2\text{S}_2\text{O}_5$	8.86	30.84	"
10.87	29.45	$\text{Na}_2\text{S}_2\text{O}_4$	6.77	43.03	"
9.63	30.70	"	5.99	34.91	" + $\text{Na}_2\text{S}_2\text{O}_5$
8.33	31.77	"	4.12	36.48	$\text{Na}_2\text{S}_2\text{O}_5$
7.22	32.70	"	3.11	37.42	"
4.46	35.34	"	1.74	38.69	"
1.78	37.93	"	0.0	40.55	"
0.0	39.75	"			

SO

100 gms. Liquid Sulfur Dioxide (SO_2) dissolve 0.023 gm. Na_2SO_3 at 0°.
(Jander and Ruppolt, 1937.)

SODIUM SULFATE $\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}$.

FREEZING-POINTS OF DILUTE AQUEOUS SOLUTIONS OF SODIUM SULFATE.
(Klein and Svanberg, 1920.)

t° of f. pt.	-0.470.	-1.057.	-1.865.
Normality of Aq. Na_2SO_4	0.1	0.25	0.50

SOLUBILITY OF SODIUM SULFATE IN WATER.
(Richards and Yugve, 1918.)

The determinations were made with the highest possible degree of accuracy. The solid phase was $\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}$ in all cases. The temperatures refer to the Paris hydrogen scale.

t° .	Gms. Na_2SO_4 per 100 gms. H_2O .	t° .	Gms. Na_2SO_4 per 100 gms. H_2O .	t° .	Gms. Na_2SO_4 per 100 gms. H_2O .
15.000...	13.181	19.000...	17.698	23.000...	23.888
16.000...	14.185	20.000...	19.064	24.000...	25.762
17.000...	15.268	21.000...	20.549	25.000...	27.795
18.000...	16.437	22.000...	22.155		

The following determinations are given by Nishizawa, 1920.

t° .	Gm. mols. Na_2SO_4 per 1000 gms. mols. H_2O .	Gms. Na_2SO_4 per 100 gms. H_2O .	Solid Phase.
15.....	16.61	13.10	$\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}$
30.....	52.01	41.02	" "
40.....	61.01	48.10	Na_2SO_4

Data for the effect of various salts upon the transition temperature of $\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}$ are given by Norton and Johnston, 1926.

SODIUM SULFATE Na_2SO_4 .**SOLUBILITY IN WATER.**

(Mulder; Löwel, 1851; Tilden and Shenstone, 1883; Etard, 1894; Funk, 1900a; Berkeley, 1904.)

t°.	Gms. Na_2SO_4 per 100 Gms.		Mols. Na_2SO_4 per Liter (B.).	Solid Phase.	t°.	Gms. Na_2SO_4 per 100 Gms.		Mols. Na_2SO_4 per Liter (B.).	Solid Phase.
	Solution.	Water.				Solution.	Water.		
0	4.76	5.0	0.31	$\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}$	50	31.8	46.7	2.92	Na_2SO_4
5	6.0	6.4	...	"	60	31.2	45.3	2.83	"
10	8.3	9.0	0.631	"	80	30.4	43.7	2.69	"
15	11.8	13.4	...	"	100	29.8	42.5	2.60	"
20	16.3	19.4	1.32	"	120	29.5	41.95	...	"
25	21.9	28.0	...	"	140	29.6	42	...	"
27.5	25.6	34.0	...	"	160	30.7	44.25	...	"
30	29.0	40.8	2.63	"	230	31.7	46.4	...	"
31	30.6	44.0	...	"	0	16.3	19.5	...	$\text{Na}_2\text{SO}_4 \cdot 7\text{H}_2\text{O}$
32	32.3	47.8	...	"	5	19.4	24	...	"
32.75	33.6	50.65	3.11	"	10	23.1	30	...	"
33	33.6	50.6	...	Na_2SO_4	15	27.0	37	...	"
35	33.4	50.2	...	"	20	30.6	44	...	"
40	32.8	48.8	3.01	"	25	34.6	53	...	"

The very carefully determined values of Berkeley are as follows:

SO

t°.	d_4 of Sat. Sol.	Gms. Na_2SO_4 per 100 Gms. H_2O .		Solid Phase.	t°.	d_4 of Sat. Sol.	Gms. Na_2SO_4 per 100 Gms. H_2O .		Solid Phase.
9.70	1.0432	4.71	$\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}$		32.5	tr. pt.	...	$\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O} + \text{Na}_2\text{SO}_4$	
10.25	1.0802	9.21	"		33.5	1.3307	49.39	Na_2SO_4	
15.65	1.1150	14.07	"		38.15	1.3229	48.47	"	
20.35	1.1546	...	"		44.85	1.3136	47.49	"	
24.90	1.2067	27.67	"		60.10	1.2918	45.22	"	
27.65	1.2459	34.05	"		75.05	1.2728	43.59	"	
30.20	1.2894	41.78	"		89.85	1.2571	42.67	"	
31.95	1.3230	47.98	"		101.9*	1.2450	42.18	"	

* B. pt.

Later determinations of the Solubility of Sodium Sulfate in Water at one or more temperatures by the following investigators, are in good agreement among themselves and with the earlier results: Küpper, 1927; Benrath, et. al., 1928; Flöttmann, 1928; Caven and Johnson, 1928; Schröder, 1929; Matsin, Oguri, Noda and Kumagi, 1929; Makarow and Wachberg, 1930; Rakowski and Nikitina, 1931; Belopolski, 1933.

The following additional data at high temperatures, determined by the sealed tube method, are given by Wuite (1913-14).

t°.	Mol. Per cent Na ₂ SO ₄ .	Gms. Na ₂ SO ₄ per 100 Gms. H ₂ O.	Solid Phase.	t°.	Mol. Per cent Na ₂ SO ₄ .	Gms. Na ₂ SO ₄ per 100 Gms. H ₂ O.	Solid Phase.
62	5.39	44.92	Na ₂ SO ₄ (rhombic)	208	5.39	44.92	Na ₂ SO ₄ (rhombic)
70	5.27	43.87	" "	235 tr. pt.	...	"	" + monoclinic
80	5.18	43.07	" "	241	5.39	44.92	Na ₂ SO ₄ (monoclinic)
120	5.04	41.84	" "	250	5.04	41.84	" "
190	5.255	43.74	" "	279	4.12	33.84	" "
192	5.27	43.87	" "	319	2.56	20.71	" "

Supersolubility curves for the ice phase, Na₂SO₄·7H₂O phase and Na₂SO₄ phase were determined by Hartley, Jones and Hutchinson (1908) by agitating mixtures of sodium sulfate and water contained in sealed tubes, and noting the points at which spontaneous crystallization occurred while the tubes were gradually cooled. The effect of mechanical friction, produced by bits of glass, garnet, etc., was also studied.

SOLUBILITY OF SODIUM SULFATE IN WATER AT
TEMPERATURES BETWEEN 140° AND 350°.
(Schroeder, Gabriel and Partridge, 1935.)

SO

The authors used a steel bomb in which the mixtures were rotated at constant temperatures maintained in an air bath. The results confirm in general those of previous workers. The following values were taken from the smoothed curve drawn from the original results.

t°	Gms. Na ₂ SO ₄ per 100 gms. H ₂ O	t°	Gms. Na ₂ SO ₄ per 100 gms. H ₂ O	t°	Gms. Na ₂ SO ₄ per 100 gms. H ₂ O	t°	Gms. Na ₂ SO ₄ per 100 gms. H ₂ O
140	42.1	200	44.1	250	44.0	310	18.5
150	42.2	210	44.2	260	41.8	320	13.1
160	42.5	220	44.8	270	38.8	330	7.3
170	43.1	230	45.6	280	35.2	340	4.2
180	43.4	235	46.0	290	30.8	350	2.4
190	43.8	241 tr. pt.	46.8	300	24.8		

A discussion of the several forms of anhydrous sodium sulfate is given.

EQUILIBRIUM IN THE SYSTEM SODIUM SULFATE
SULFURIC ACID AND WATER AT 12.5°.
(Montemartini and Losana, 1928.)

d. of sat. sol.	Gms. per 100 Na ₂ SO ₄	Gms. sat. sol. H ₂ SO ₄	Solid Phase	d. of sat. sol.	Gms. per 100 Na ₂ SO ₄	Gms. sat. sol. H ₂ SO ₄	Solid Phase
1.0865	9.46	0	Na. 10	1.4080	10.86	36.91	NaH. 1
1.2746	19.26	11.86	" + NaH. 5 (1)	1.4752	3.68	51.62	" (3)
1.2608	30.40	18.73	Na + " (2)	1.5720	3.71	59.42	NaH
1.4801	31.56	20.58	" + "	1.6562	4.75	70.62	" + NaH. H
1.4868	30.15	22.06	" + "	1.7780	5.65	81.74	NaH. H
1.4876	25.06	27.96	" + " + NaH. 1	1.9254	9.98	89.06	"

(1) Traces of Na₂SO₄ (?); (2) Traces of Na. 10 (?); (3) Traces of NaH
Na. 10 = Na₂SO₄·10H₂O; NaH. 5 = NaHSO₄·5H₂O; NaH. 1 = NaHSO₄·H₂O; NaH =
NaHSO₄; NaH. H = NaHSO₄·H₂SO₄.

SOLUBILITY OF SODIUM SULFATE IN AQUEOUS SOLUTIONS OF SULFURIC
ACID AT 25°.

(D'Ans, 1906; 1909c; 1913.)

Mols. per 1000 Gms. Sat. Sol.		Solid Phase.	Mols. per 1000 Gms. Sat. Sol.		Solid Phase.
H ₂ SO ₄ .	Na ₂ SO ₄ .		SO ₃ .	Na ₂ SO ₄ .	
0	1.541	Na ₂ SO ₄ .10H ₂ O	8.70	0.076	NaH ₃ (SO ₄) ₂ .H ₂ O
0.286	1.671	"	8.86	0.156	"
0.338	1.742	"	8.93	0.273	"
0.60	1.85	"	8.84	0.527	" (unstable)
0.763	2	"	8.70	0.808	" "
0.884	2.256	" + Na ₂ SO ₄	8.62	0.844	" "
0.423	0.77	NaHSO ₄ .H ₂ O	8.61	0.899	"
0.496	0.47	"	8.87	0.445	" + Na ₂ SO ₄ .4½H ₂ SO ₄
1.666	2.437	Na ₂ SO ₄ +Na ₂ H(SO ₄) ₂	8.93	0.437	Na ₂ SO ₄ .4½H ₂ SO ₄
1.576	2.363	" + Na ₂ H(SO ₄) ₂ .H ₂ O	9.08	0.394	"
2.611	2.091	Na ₂ H(SO ₄) ₂ + "	9.36	0.425	" + NaHS ₂ O ₇
5.91*	0.409	NaHSO ₄	9.18	0.567	NaHS ₂ O ₇
6.30	0.332	"	9.42	0.728	"
6.64	0.297	" + NaH ₃ (SO ₄) ₂ .H ₂ O	9.48	0.76	"
6.90	0.173	NaH ₃ (SO ₄) ₂ .H ₂ O	9.48	0.953	" +?
7.36	0.071	"	9.85	0.787	?
7.74	0.047	"	9.98	0.908	?
8.12	0.037	"	9.77	1.03	unstable
8.40	0.046	"	10.16	0.797	
			10.78	0.302	

* From this point on the figures in this column are Mols.SO₃ = H₂SO₄ + SO₃.

SO

100 cc. sat. solution of Na₂SO₄ in absolute H₂SO₄ contain 29.99 gms. Na₂SO₄ and the molecular compound which is formed contains 8 mols. H₂SO₄ per 1 mol. Na₂SO₄ and melts at about 40°.

(Bergius, 1910.)

Aqueous H₂SO₄ containing 0.51 mol. per liter dissolve 2.238 mols. Na₂SO₄ per liter at 25°; Aq. H₂SO₄ of 0.779 mol. per liter dissolves 2.465 mols. Na₂SO₄ at the same temperature.

(Herz, 1911-12.)

100 gms. H₂O dissolve 30 gms. NaHSO₄ at 16°.

(Aschan, 1913.)

100 gms. H₂O dissolve 28.6 gms. NaHSO₄ at 25° and 50 gms. at 100°.

(U. S. P. VIII.)

100 gms. 95 per cent alcohol dissolve about 1.4 gms. NaHSO₄ at 25°.

(U. S. P. VIII.)

100 gms. 95% formic acid dissolve 30 gms. NaHSO₄ at 19.3°.

(Aschan, 1913.)

EQUILIBRIUM IN THE SYSTEM SODIUM SULFATE, SULFURIC ACID AND WATER.
(Pascal and Ero, 1919; Faust and Esselmann, 1926; Foote, 1919).

t°.	Gms. per 100 gms. sat. sol.		Solid Phase.	Gms. per 100 gms. sat. sol.		Solid Phase.
	Na ₂ SO ₄ .	H ₂ SO ₄ .		Na ₂ SO ₄ .	H ₂ SO ₄ .	
Results by Pascal and Ero.						
—45...	1.6	42.8	Na ₂ H(SO ₄) ₂ + Na ₂ SO ₄ ·10 H ₂ O	13.94	8.75	Na ₂ SO ₄ ·10 H ₂ O
—30...	1.6	42.8	Na ₂ H(SO ₄) ₂	25.55	14.96	»
—30...	2.30	37.10	»	33.30	16.70	» + Na ₂ SO ₄
—30...	3.10	26.80*	»	25.74	25.05	Na ₂ H(SO ₄) ₂
—24...	3.0	30.0	Ice	16.23	33.60	»
—24...	7.5	35.0	Ice + Na ₂ H(SO ₄) ₂ + Na ₂ SO ₄ ·10 H ₂ O	4.95	45.90	» + NaH(SO ₄) ₂ ·H ₂ O
—21...	7.5	40.0	NaH(SO ₄) ₂ ·H ₂ O	4.19	48.60	NaH(SO ₄) ₂ ·H ₂ O
—1...	7.5	40.0*	»	3.96	58.78	NaH(SO ₄) ₂
—17...	3.0	24.25	Ice	0.95	70.80	»
—11...	10.0	30.0	Na ₂ SO ₄ ·10 H ₂ O	0.19	81.70	NaH ₂ (SO ₄) ₂ ·1 1/2 H ₂ O
—10...	5.0	15.0	» + Ice	3.02	88.70	»
—9...	3.0	12.5	Ice	Results by Foote at 12°.0.		
—7...	10.0	22.5	Na ₂ SO ₄ ·10 H ₂ O	9.53	0.0	Na ₂ SO ₄ ·10 H ₂ O
—6...	4.0	45.0	Na ₂ H(SO ₄) ₂	32.93	16.51	» + Na ₂ H(SO ₄) ₂
—3...	9.1	32.1*	NaH(SO ₄) ₂ ·H ₂ O	25.41	27.96	NaH(SO ₄) ₂ ·H ₂ O + Na ₂ H(SO ₄) ₂
—3...	10.25	10.9	Na ₂ SO ₄ ·10 H ₂ O	4.33	58.79	NaH(SO ₄) ₂ ·H ₂ O (divariant)
—3...	16.0	27.1	Na ₂ H(SO ₄) ₂	Results by Pascal and Ero at 14°.0.		
—3...	20.1	22.4	»	25.9	0.0	Na ₂ SO ₄ ·7 H ₂ O
Results by Faust and Esselmann at 0°.				34.15	9.5	»
5.98	6.74			19.81	7.13	Na ₂ SO ₄ ·10 H ₂ O
7.9	14.75			28.50	13.40	»
11.5	20.5			33.35	20.19	Na ₂ SO ₄
14.44	21.64	Na ₂ SO ₄ ·10 H ₂ O		28.58	24.54	Na ₂ H(SO ₄) ₂
20.01	21.69	»		22.77	29.97	»
23.01	21.52	»		17.74	33.88	»
28.3	22.07	»		5.63	48.12	NaH(SO ₄) ₂ ·H ₂ O
27.85	22.66	Na ₂ H(SO ₄) ₂		4.54	58.68	NaH(SO ₄) ₂
26.25	23.81			8.68	58.68*	NaH(SO ₄) ₂ ·H ₂ O
25.70	24.13			2.09	63.78	NaH(SO ₄) ₂
22.95	26.08	Na ₂ H(SO ₄) ₂ ·H ₂ O		1.20	70.76	»
18.67	29.35	»		0.35	81.66	NaH ₂ (SO ₄) ₂ ·1 1/2 H ₂ O
16.45	30.74	NaH(SO ₄) ₂ ·H ₂ O		0.32	81.68	»
13.88	32.73	»		3.44	87.92	NaH ₂ (SO ₄) ₂
13.01	33.13			3.64	88.30	»
9.62	34.59			5.95	91.69*	NaH ₂ (SO ₄) ₂ ·1 1/2 H ₂ O
7.66	37.21			15.05	85.00	NaH ₂ (SO ₄) ₂
3.98	43.31	NaH(SO ₄) ₂ ·H ₂ O		33.70	23.30 (15°)	Na ₂ H(SO ₄) ₂
2.11	57.5			Results by Pascal and Ero at 23°.		
2.38	58.46	NaH(SO ₄) ₂ ·H ₂ O		29.29	10.11	Na ₂ SO ₄ ·10 H ₂ O
2.79	60.00			35.52	13.37	»
3.05	61.30			34.05	13.56	» + Na ₂ SO ₄
3.44	62.60	NaH(SO ₄) ₂		34.65	19.38	Na ₂ SO ₄
3.36	62.87			30.08	26.61	Na ₂ H(SO ₄) ₂
0.0	69.90			9.42	43.76	»
				6.23	56.09	NaH(SO ₄) ₂ ·H ₂ O + NaH(SO ₄) ₂
				2.78	63.93	NaH(SO ₄) ₂
				7.54	64.06*	NaH(SO ₄) ₂ ·H ₂ O
				1.84	79.40	NaH ₂ (SO ₄) ₂ ·1 1/2 H ₂ O
				14.74	83.89	NaH ₂ (SO ₄) ₂
				3.95	87.29	» + NaH ₂ (SO ₄) ₂ ·1 1/2 H ₂ O

* = Metastable.

* = Metastable.

EQUILIBRIUM IN THE SYSTEM SODIUM SULFATE, SULFURIC ACID
AND WATER (CON.). (Pascal and Ero, 1919; Faust and Esselmann, 1926; Foote, 1919.)

Gms. per 100 gms. sat. sol.		Solid Phase.	Gms. per 100 gms. sat. sol.		Solid Phase.
Na ₂ SO ₄ .	H ₂ SO ₄ .		Na ₂ SO ₄ .	H ₂ SO ₄ .	
Results by Foote at 25°.			Results by Faust and Esselmann at 46° 0.		
21.90	0.0	Na ₂ SO ₄ · 10H ₂ O	32.4	3.47	Na ₂ SO ₄
33.48	8.62	» + Na ₂ SO ₄	32.54	6.27	»
35.36	16.27	Na ₃ H(SO ₄) ₂ + »	32.52	6.8	»
27.02	30.58	» + NaHSO ₄ · H ₂ O	33.01	10.8	»
6.54	56.25	NaHSO ₄ · H ₂ O (divariant)	34.08	14.4	»
Results by Faust and Esselmann at 29° 5.			34.17	14.9	»
32.22	3.06	Na ₂ SO ₄ · 10H ₂ O	34.14	14.87	»
32.89	3.99	Na ₂ SO ₄	34.57	15.86	»
32.84	5.18	»	34.60	16.17	»
32.60	6.99	»	36.00	18.08	»
32.42	8.94	»	35.94	18.12	»
32.51	10.05	»	35.63	19.18	»
33.34	13.83	»	35.45	20.16	»
33.75	14.38	»	34.97	21.32	»
34.02	15.60	»	34.73	22.93	»
34.37	17.31	»	34.52	23.04	»
33.49	19.10	Na ₃ H(SO ₄) ₂	34.40	24.60	Na ₃ H(SO ₄) ₂
33.19	19.49	»	33.59	27.2	»
32.69	21.45	»	33.25	28.48	»
32.38	22.35	»	33.15	29.3	»
30.86	24.98	»	33.07	30.18	»
29.79	27.35	»	33.01	33.16	»
28.72	29.89	»	33.27	33.44	»
28.32	30.60	»	33.22	33.08	»
27.81	32.53	»	33.25	35.36	NaHSO ₄ · H ₂ O
26.87	32.64	»	32.65	35.70	»
26.54	32.79	NaHSO ₄ · H ₂ O	30.95	36.5	»
19.62	36.65	»	21.2	43.9	»
19.00	37.22	»	20.5	44.52	»
10.51	45.50	»	19.85	45.17	»
8.96	48.15	»	17.71	48.5	»
8.35	49.49	»	17.76	48.32	»
7.85	55.13	» + NaHSO ₄	17.13	49.6	»
5.70	59.96	NaHSO ₄	14.21	51.31	NaHSO ₄
4.59	62.55	»	12.41	52.65	»
4.31	65.55	»	10.2	55.5	»
12.7	82.91	»	9.93	56.0	»
9.3	84.25	»	6.82	61.79	»
Results by Pascal and Ero at 36° 0.			6.4	62.46	»
35.54	19.31	Na ₂ SO ₄	6.16	64.8	»
32.98	26.46	Na ₃ H(SO ₄) ₂	6.04	65.59	»
37.89	26.98*	Na ₂ SO ₄	4.51	67.76	»
17.61	42.34	NaHSO ₄ · H ₂ O	2.3	74.83	(?)
12.53	53.07	»	7.5	72.16	»
6.05	65.41	NaHSO ₄	1.92	78.58	»
18.09	86.96	NaH ₃ (SO ₄) ₂	13.22	80.44	(?)
6.69	86.20	»			

* = Metastable.

EQUILIBRIUM IN THE SYSTEM SODIUM SULFATE, SULFURIC ACID
AND WATER (CON.).

(Pascal and Ero, 1919; Faust and Esselmann, 1926.)

Gms. per 100 gms. sat. sol.		Solid Phase.	Gms. per 100 gms. sat. sol.		Solid Phase.
Na ₂ SO ₄ .	H ₂ SO ₄ .		Na ₂ SO ₄ .	H ₂ SO ₄ .	
Results by Pascal and Ero at 56°.			Results of Faust and Esselmann at 82°.		
34.63	8.47	Na ₂ SO ₄	31.72	6.49	Na ₂ SO ₄
34.99	12.81	"	32.83	10.48	"
36.65	18.69	"	36.44	16.88	"
36.88	25.10	Na ₃ H(SO ₄) ₂	38.63	19.73	"
40.51	33.21*	NaHSO ₄ ·H ₂ O	38.85	20.20	"
19.86	51.15	"	39.20	25.0	Na ₃ H(SO ₄) ₂
33.00	41.35	"	40.63	28.86	"
11.57	60.45	NaHSO ₄	41.24	30.17	"
8.44	62.72	"	42.25	32.15	"
5.24	74.63	NaHSO ₄ ·H ₂ O	44.20	35.15	"
5.68	76.54	NaH ₃ (SO ₄) ₂ ·1 1/2 H ₂ O	45.37	36.14	"
4.49	78.30	"	46.20	36.55	"
21.54	78.46	NaH ₃ (SO ₄) ₂	39.02	41.04	NaHSO ₄
15.20	81.15	"	34.80	44.00	"
9.30	83.25	"	28.78	47.55	"
Result by Faust and Esselmann at 60°.			23.62	50.64	"
32.27	4.66	Na ₂ SO ₄	25.5	49.78	"
33.70	13.13	"	20.84	53.9	"
34.26	14.71	"	19.42	54.35	"
37.03	19.00	"	16.45	56.99	"
36.86	22.1	Na ₃ H(SO ₄) ₂	10.97	65.07	"
36.48	25.6	"	11.9	65.5	"
37.0	29.87	"	24.67	71.38	(?)
38.22	34.26	"	10.56	71.44	(?)
33.04	41.77	"	10.06	72.26	"
31.24	42.53	NaHSO ₄	21.43	73.00	"
17.72	51.25	"	19.37	73.12	"
13.27	55.36	"	11.47	75.44	"
8.22	63.75	"	11.20	75.73	"
8.21	67.79	"	Results by Pascal and Ero at 97°.		
11.33	73.65		34.89	8.53	Na ₂ SO ₄
16.60	77.78		44.34	15.03	"
15.93	78.6		44.22	20.22	"
3.2	78.69	(?)	44.37	24.02	Na ₃ H(SO ₄) ₂
3.3	79.32		44.13	31.91	"
13.59	80.8		44.10	33.10	"
5.14	81.01	NaHSO ₄	48.29	34.20	"
Results of Pascal and Ero at 75°.			51.89	35.53	NaHSO ₄ ·H ₂ O
41.80	23.10	Na ₂ SO ₄ + Na ₃ H(SO ₄) ₂	37.78	42.97	NaHSO ₄
42.40	31.80	Na ₃ H(SO ₄) ₂	21.02	56.60	"
20.10	55.20	NaHSO ₄ + NaHSO ₄ ·H ₂ O	15.88	61.92	"
11.10	63.40	NaHSO ₄	15.60	65.00	"
12.30	69.80	"	20.43	68.09	"
13.40	77.40	NaH ₃ (SO ₄) ₂	21.71	70.98	NaH ₃ (SO ₄) ₂
24.90	75.30	"	29.43	71.16	"
* = Métastable.			27.60	72.50	2 NaHSO ₄ ·H ₂ SO ₄
			18.0	73.20*	NaHSO ₄

EQUILIBRIUM IN THE SYSTEM SODIUM SULFATE, SULFURIC ACID AND WATER (CON.).
(Pascal and Ero, 1919.)

t°.	Gms. per 100 gms. sat. sol.		Solid Phase.	t°.	Gms. per 100 gms. sat. sol.		Solid Phase.
	Na ₂ SO ₄ .	H ₂ SO ₄ .			Na ₂ SO ₄ .	H ₂ SO ₄ .	
120...	49.00	32.67	Na ₃ H(SO ₄) ₂	169.5.	50.20	44.75	NaHSO ₄ .
120...	50.10	34.50	"	159.5.	47.23	48.67	"
120...	53.20	36.50	NaHSO ₄ .	160.5.	45.00	49.20	"
120...	32.26	51.20	"	149.5.	40.41	52.09	"
120...	26.80	57.70	"	91.5.	45.00	38.50	NaHSO ₄ .H ₂ O
120.	27.50	64.55	"	>145...	45.00	33.00	Na ₂ SO ₄ .
120...	35.61	64.58	"	>170...	57.20	29.05	"

Freezing-point data for mixtures of sodium sulfate and sulfuric acid are given by Kendall and Landon, 1920, and Cambi and Bozza, 1923. Results for mixtures of sodium pyrosulfate and sodium bisulfate are given by Cambi and Bozza, 1923

EQUILIBRIUM IN THE SYSTEM SODIUM SULFATE, SULFURIC ACID AND ETHYL ALCOHOL.
(Dunnelliff and Hoon, 1926.)

The authors studied the action of alcohol upon sodium hydrogen sulfate and found that the maximum concentration of acid obtained in the liquid phase was 17.75 per cent. With quantities of salt necessary to yield higher concentrations it was impossible to separate the liquid phase and the « Rest ». Hence the system could not be further investigated by this method. They then studied the action of alcoholic sulfuric acid solutions upon sodium sulfate and sodium hydrogen sulfate. The experimental results are not presented in a manner which can be easily understood.

SOLUBILITY OF SODIUM SULFATE IN PURE HYDROGEN PEROXIDE.
(Maass and Hatcher, 1922.)

The temperatures were determined at which the last trace of solid disappeared from mixtures of accurately weighed amounts of the two compounds.

t°.	Gms. Na ₂ SO ₄ per 100 gms. mixture.	t°.	Gms. Na ₂ SO ₄ per 100 gms. mixture.	t°.	Gms. Na ₂ SO ₄ per 100 gms. mixture.
-2.17.....	1.19	-5.52.....	10.23	+19.6...	22.64
-2.87.....	2.56	-6.77.....	13.51	29.1.....	23.59
-3.12.....	4.47	-9.02.....	16.77	39.1.....	25.62
-4.27.....	6.92	-10.57.....	19.47		

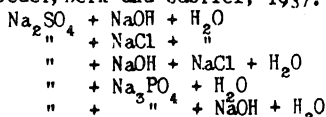
SOLUBILITY OF SODIUM SULFATE IN AQUEOUS SOLUTIONS OF AMMONIA AT 35°
(Fedotieff and Kolossoff, 1923.)

d of sat. sol.	Gms. per 100 cc. sat. sol.		Gms. per 100 gms. H ₂ O.	
	Na ₂ SO ₄ .	NH ₃ .	Na ₂ SO ₄ .	NH ₃ .
1.202.....	28.76	4.84	33.23	5.65
1.169.....	25.39	6.08	29.71	6.49
1.137.....	21.98	6.59	25.83	7.75

SOLUBILITY OF SODIUM SULFATE IN AQUEOUS SOLUTIONS OF SODIUM HYDROXIDE AT 25°.
(D'Ans and Schreiner, 1910.)

Mols. per 1000 Gms. Sat. Sol.		Solid Phase.	Mols. per 1000 Gms. Sat. Sol.		Solid Phase.
(NaOH) ₂ .	Na ₂ SO ₄ .		(NaOH) ₂ .	Na ₂ SO ₄ .	
0.074	1.41	Na ₂ SO ₄ .10H ₂ O	2.82	0.24	Na ₂ SO ₄ .
0.70	1.08	"	3.52	0.126	"
1.47	0.90	" + Na ₂ SO ₄ .	5.83	0.013	"
2.02	0.59	Na ₂ SO ₄ .	6.62	0	NaOH.H ₂ O

Data for the equilibrium in the following systems at temperatures between 150° and 350° are given by Schroeder, Gabriel and Partridge, 1935, and Schroeder, Berk and Gabriel, 1937.



The determinations were made in connection with boiler feed-water studies.

EQUILIBRIUM IN THE SYSTEM SODIUM SULFATE, SODIUM THIOSULFATE AND WATER.
(Garran, 1926.)

Saturation was obtained by constant agitation in a thermostat for from 3 to 24 hours. M. C. indicates mixed crystals and the formula following shows the major constituent. * indicates metastable equilibrium.

d of sat. sol.	Gms. per 100 gms. sat. sol.		Solid Phase.	d of sat. sol.	Gms. per 100 gms. sat. sol.		Solid Phase.
	Na ₂ SO ₄ .	Na ₂ S ₂ O ₃ .			Na ₂ SO ₄ .	Na ₂ S ₂ O ₃ .	
Results at 0°.8.				Results at 25°.			
1.040	4.60	0.0	Na ₂ SO ₄ .10H ₂ O	—	12.72	26.86	M.C.Na ₂ SO ₄ .10H ₂ O +M.C.Na ₂ SO ₄
1.065	3.13	4.48	M.C.Na ₂ SO ₄ .10H ₂ O	—	12.72	26.85	
1.105	2.31	9.63	»	—	13.27	26.12*	M.C.Na ₂ SO ₄
1.159	1.88	16.03	»	1.379	12.15	28.00	»
1.190	1.87	19.62	»	—	10.28	30.31	»
1.247	1.56	25.63	»	1.401	7.73	34.72	»
—	1.34	30.07	»	—	6.06	38.07	»
1.312	1.27	32.26	»	—	4.53	41.86*	»
1.324	1.58	33.91*	»	1.453	4.87	43.32*	»
1.314	1.22	32.72	»+M.C.Na ₂ S ₂ O ₃ .5H ₂ O	—	5.59	38.83	M.C.Na ₂ SO ₄ +M.C.Na ₂ S ₂ O ₃ .5H ₂ O
1.317	1.15	32.72		—	5.66	38.67	
1.317	1.44	32.72	M.C.Na ₂ S ₂ O ₃ .5H ₂ O	1.426	5.64	38.97	
1.315	—	33.57	Na ₂ S ₂ O ₃ .5H ₂ O	1.420	5.42	38.85	
Results at 18°.				—	5.20	38.96	
SO 1.130	14.11	0.0	Na ₂ SO ₄ .10H ₂ O	1.418	4.69	39.45	M.C.Na ₂ S ₂ O ₃ .5H ₂ O
1.150	12.31	4.01	M.C.Na ₂ SO ₄ .10H ₂ O	1.412	3.13	40.92	»
1.180	10.71	9.36	»	1.411	2.01	41.53	»
1.194	9.83	11.34	»	1.410	0.23	43.52	»
1.225	8.45	15.86	»	—	0.0	43.50	Na ₂ S ₂ O ₃ .5H ₂ O
1.248	7.65	19.16	»	Results at 40°.			
1.276	7.14	22.46	»	—	32.37	0.0	Na ₂ SO ₄
1.301	6.01	25.53	»	—	29.35	3.79	M.C.Na ₂ SO ₄
1.314	5.97	27.00	»	1.326	24.79	9.06	»
1.338	6.04	29.57	»	1.334	18.58	16.73	»
1.356	6.32	32.31	»	—	14.76	22.95	»
1.374	5.94	33.66	»	1.367	11.14	28.06	»
1.390	6.14	35.07	»	—	10.40	30.44	»
1.399	6.26	35.42	»+M.C.Na ₂ S ₂ O ₃ .5H ₂ O	1.383	8.13	34.35	»
1.394	6.31	35.46	M.C.Na ₂ S ₂ O ₃ .5H ₂ O	—	5.90	39.74	»
1.395	4.87	36.61	»	1.444	4.28	43.06	»
1.384	1.65	39.12	»	1.484	2.46	48.78	»
1.378	0.0	40.36	Na ₂ S ₂ O ₃ .5H ₂ O	—	1.79	51.04*	»
Results at 25°.				—	2.03	52.10*	»
1.204	21.60	0.0	Na ₂ SO ₄ .10H ₂ O	1.496	2.27	49.38	M.C.Na ₂ SO ₄ +M.C.Na ₂ S ₂ O ₃ .5H ₂ O
1.215	19.74	3.48	M.C.Na ₂ SO ₄ .10H ₂ O	1.496	2.08	49.72	
1.236	18.44	7.30	»	1.494	2.24	49.73	
1.253	17.12	10.14	»	—	2.09	49.97	M.C.Na ₂ S ₂ O ₃ .5H ₂ O
1.271	16.13	13.22	»	—	3.61	49.60*	
1.288	14.86	16.16	»	1.493	2.14	49.88	»
1.311	13.97	19.35	»	—	2.45	49.98	»
—	13.62	22.02	»	—	1.58	50.15	»
1.359	12.97	24.96	»	1.492	0.67	50.49	»
				1.488	0.0	51.23	Na ₂ S ₂ O ₃ .5H ₂ O

SOLUBILITY OF SODIUM SULFATE IN AQUEOUS SOLUTIONS OF SODIUM
ACETATE AT 25°.

(Fox, 1909.)

Gms. per 100	Gms. Sat. Sol.	Solid Phase.	Gms. per 100	Gms. Sat. Sol.	Solid Phase.
CH ₃ COONa.	Na ₂ SO ₄ .		CH ₃ COONa.	Na ₂ SO ₄ .	
0	21.9	Na ₂ SO ₄ ·10H ₂ O	12.58	13.50	Na ₂ SO ₄ ·10H ₂ O
4.10	17.72	"	16.26	11.50	"
7.71	16.48	"	20.68	8.10	"

SOLUBILITY OF MIXTURES OF NICKEL SULPHATE AND SODIUM SUL-
PHATE, ETC.

(Koppel; Wetzel — Z. physik. Chem. 52, 401, '05.)

t°.	Gms. per 100 Gms. Solution.		Gms. per 100 Gms. H ₂ O.		Mols. per 100 Mols. H ₂ O.		Solid Phase.
	NiSO ₄ .	Na ₂ SO ₄ .	NiSO ₄ .	Na ₂ SO ₄ .	NiSO ₄ .	Na ₂ SO ₄ .	
0	16.94	7.61	22.46	10.09	2.61	1.28	NiSO ₄ ·7H ₂ O + Na ₂ SO ₄ ·10H ₂ O
5	17.99	10.85	25.28	15.24	2.94	1.93	
10	18.97	13.85	28.26	20.64	3.29	2.61	
20	18.76	17.21	29.31	26.87	3.410	3.404	NiNa ₂ (SO ₄) ₂ ·4H ₂ O
25	17.85	16.54	27.33	25.33	3.181	3.208	"
30	16.74	15.34	24.64	22.58	2.868	2.861	"
35	16.28	14.91	23.66	21.67	2.753	2.744	"
40	15.35	14.49	21.88	20.65	2.546	2.616	"
18.5	19.61	16.49	30.70	25.80	3.56	3.27	NiNa ₂ (SO ₄) ₂ ·4H ₂ O + NiSO ₄ ·7H ₂ O
20	20.13	16.15	31.59	25.35	3.67	3.21	
25	21.20	14.77	33.11	23.06	3.85	2.92	
30	22.60	12.80	34.98	19.82	4.07	2.59	
35	23.62	10.78	36.01	16.43	4.19	2.08	
40	24.92	9.39	37.93	14.29	4.41	1.81	NiNa ₂ (SO ₄) ₂ ·4H ₂ O + Na ₂ SO ₄ ·10H ₂ O
18.5	16.80	18.93	26.14	29.45	3.04	3.72	
20	15.48	20.18	24.06	31.37	2.80	3.97	
25	10.92	24.12	16.81	37.13	1.96	4.70	NiNa ₂ (SO ₄) ₂ ·4H ₂ O + Na ₂ SO ₄
30	6.40	28.71	9.87	44.25	1.15	5.60	
35	4.54	31.65	7.13	49.59	0.838	6.28	
40	4.63	31.37	7.24	49.03	0.843	6.21	

SO

(Benrath and Benrath, 1929; Benrath, 1931.)

50

(Zambonini and Restanio, 1931.)

$$5.4.8\text{H}_2\text{O} = 5\text{Na}_2\text{SO}_4 \cdot 4\text{Pr}_2(\text{SO}_4)_3 \cdot 8\text{H}_2\text{O}; \quad 1.1.2\text{H}_2\text{O} = \text{Na}_2\text{SO}_4 \cdot \text{Pr}_2(\text{SO}_4)_3 \cdot 2\text{H}_2\text{O}.$$

(Restano, 1934.)

$$4.5.8 = 4\text{Sm}_2(\text{SO}_4)_3 \cdot 5\text{Na}_2\text{SO}_4 \cdot 8\text{H}_2\text{O}; \quad 1.1.2 = \text{Sm}_2(\text{SO}_4)_3 \cdot \text{Na}_2\text{SO}_4 \cdot 2\text{H}_2\text{O}.$$

EQUILIBRIUM IN THE SYSTEM SODIUM SULFATE, ZINC SULFATE AND WATER.
(Caven and Johnston, 1938.)

Results at 0°

Results at 25°

Gm. Mols. per 1000 Gms. H ₂ O		Solid Phase	Gm. Mols. per 1000 Gms. H ₂ O		Solid Phase
ZnSO ₄	Na ₂ SO ₄		ZnSO ₄	Na ₂ SO ₄	
0.0	0.331	Na ₂ SO ₄ · 10H ₂ O	0.0	1.972	Na ₂ SO ₄ · 10H ₂ O
0.128	0.347	"	0.543	2.023	"
0.414	0.366	"	1.226	2.087	" + 1.1.4
0.600	0.381	"	1.987	1.322	1.1.4
0.914	0.388	"	2.669	0.871	"
1.386	0.463	"	2.922	0.745	"
2.494	0.485	"	3.157	0.641	"
2.521	0.492	" + ZnSO ₄ · 7H ₂ O	3.463	0.551	" + ZnSO ₄ · 7H ₂ O
2.568	0.122	ZnSO ₄ · 7H ₂ O	3.504	0.255	ZnSO ₄ · 7H ₂ O
2.589	0.00	"	3.515	0.0	"

1.1.4 = Na₂SO₄ · ZnSO₄ · 4H₂O

SOLUBILITY OF ZINC SULFATE - SODIUM SULFATE MIXTURES IN WATER.
(Koppel, Gumpert, 1905.)

t°	Gms. per 100 Gms. Solution.		Gms. per 100 Gms. H ₂ O.		Mols. per 100 Mols. H ₂ O.		Solid Phase.
	ZnSO ₄	Na ₂ SO ₄	ZnSO ₄	Na ₂ SO ₄	ZnSO ₄	Na ₂ SO ₄	
0	27.10	5.33	40.30	7.90	4.80	1.01	ZnSO ₄ · 7H ₂ O + Na ₂ SO ₄ · 10H ₂ O
5	27.85	0.27	42.28	0.52	4.71	1.21	
25	17.58	15.63	26.32	23.40	2.04	2.00	ZnNa ₂ (SO ₄) ₂ · 4H ₂ O
30	17.66	15.58	26.47	23.44	2.05	2.07	"
35	17.50	15.70	26.36	23.52	2.04	2.08	"
40	17.75	15.72	26.68	23.63	2.08	2.00	"
10	20.16	7.16	45.70	11.24	5.11	1.42	ZnNa ₂ (SO ₄) ₂ · 4H ₂ O + ZnSO ₄ · 7H ₂ O
15	30.70	6.40	48.81	10.17	5.45	1.20	
20	32.51	5.36	52.34	8.62	5.84	1.00	
25	34.36	4.41	56.15	7.22	6.27	0.91	
30	36.28	3.80	60.55	6.34	6.76	0.81	
35	38.18	3.30	65.25	5.64	7.28	0.71	ZnNa ₂ (SO ₄) ₂ · 4H ₂ O + ZnSO ₄ · 7H ₂ O
38	38.83	2.90	66.64	4.98	7.44	0.63	
40	38.26	2.78	64.80	4.71	7.24	0.60	
10	27.91	7.92	43.50	12.34	4.85	1.565	ZnNa ₂ (SO ₄) ₂ · 4H ₂ O + Na ₂ SO ₄ · 10H ₂ O
15	24.28	16.00	36.92	16.71	4.12	2.12	
20	19.14	14.58	28.77	21.95	3.21	2.79	
25	13.31	19.94	19.93	29.87	2.22	3.785	
30	6.96	27.75	10.67	42.51	1.19	5.39	
35	5.61	30.63	8.72	46.61	0.971	5.91	ZnNa ₂ (SO ₄) ₂ · 4H ₂ O + Na ₂ SO ₄
40	5.96	28.65	9.16	43.83	1.02	5.555	

EQUILIBRIUM IN THE SYSTEM SODIUM SULFATE, ZINC SULFATE AND WATER.
(Benrath and Benrath, 1929; Benrath, 1930.)

Gms. per 100 gms. sat. sol.		Solid Phase	d. of sat. sol.	Gms. per 100 gms. sat. sol.		Solid Phase
ZnSO ₄	Na ₂ SO ₄			ZnSO ₄	Na ₂ SO ₄	
Results at 50°			Results at 97°			
6.48	28.19	Na ₂ SO ₄ + 1.1.4	1.237	0.0	30.50	Na ₂ SO ₄
41.47	2.72	Zn.6 + "	1.279	3.36	29.27	"
			1.301	5.67	28.45	"
Results at 68°			1.315	6.17	28.43	" + 3.1
			—	8.68	26.24	3.1
39.82	4.05	Zn.1 + 1.1.4	1.352	12.16	24.24	"
			—	15.77	22.00	"
Results at 75°			1.398	18.12	20.60	" + 1.1.4
			1.421	21.37	17.84	1.1.4
38.30	4.71	Zn.1 + 1.1.4	1.435	25.04	14.76	"
10.54	24.52	3.1 + "	1.506	30.92	11.40	"
6.54	27.75	" + Na ₂ SO ₄	1.561	35.70	9.18	"
			1.532	34.50	9.30	" + Zn.1
Results at 80°			1.509	35.93	5.14	Zn.1
			1.510	36.05	4.45	"
1.73	29.67	Na ₂ SO ₄	1.532	41.23	0.0	"
6.45	27.55	3.1	Results at 100°			
8.19	26.19	"				
11.38	23.80	" + 1.1.4	—	32.55	10.31	Zn.1 + 1.1.4
12.78	22.78	1.1.4	—	17.66	20.71	3.1 + "
18.49	16.88	"	—	6.12	27.96	" + Na ₂ SO ₄
28.05	9.27	"				
36.53	5.77	" + Zn.1				
37.14	5.29	Zn.1	1.1.4 =	Na ₂ SO ₄ · ZnSO ₄ · 4H ₂ O		
39.06	2.02	"	3.1 =	3Na ₂ SO ₄ · ZnSO ₄		
40.56	0.0	"	Zn.6 =	ZnSO ₄ · 6H ₂ O; Zn.1 = ZnSO ₄ · H ₂ O		

SOLUBILITY OF SODIUM SULFATE IN AQUEOUS SOLUTIONS OF
ETHYL ALCOHOL AT 25°.

(Flatt and Jordan, 1933.)

Wt. % C_2H_5OH in solvent	Wt. % C_2H_5OH in solvent after saturation	Gms. Na_2SO_4 per 100 cc sat. sol.	Gms. Na_2SO_4 per solvent	Gms. Na_2SO_4 per 100 gms. sat. sol.	Solid Phase
0.0	0.0	27.77	27.85	21.78	$Na_2SO_4 \cdot 10H_2O$
20.4	18.6	6.795	7.017	6.557	"
37.3	36.7	1.177	1.254	1.239	"
—	52.9	0.352	0.390	0.388	"

SOLUBILITY OF SODIUM SULFATE IN AQUEOUS ETHYL ALCOHOL.
(de Bruyn, 1900.)

t°.	Concentration of Alcohol in Wt. %.	Gms. Na ₂ SO ₄ per 100 Gms. Aq. Alcohol.	Gms. per 100 Gms. Solution.			Solid Phase.
			H ₂ O.	C ₂ H ₅ OH.	Na ₂ SO ₄ .	
15	0	12.7	88.7	0	11.3	Na ₂ SO ₄ .10H ₂ O
"	9.2	6.7	85.1	8.6	6.3	"
"	19.4	2.6	78.6	18.9	2.5	"
"	39.7	0.5	60	39.5	0.5	"
"	58.9	0.1	41.1	58.8	0.1	"
"	72	0	28	72	0	"
"	0	37.4	72.8	0	27.2	Na ₂ SO ₄ .7H ₂ O
"	11.2	16.3	76.5	9.5	14	"
"	20.6	7	74.3	19.2	6.5	"
"	30.2	2	68.4	29.6	2	"
25	0	28.2	78.1	0	21.9	Na ₂ SO ₄ .10H ₂ O
"	10.6	13.9	78.5	9.3	12.2	"
"	24	4.5	72.8	22.9	4.3	"
"	54	0.4	45.6	54	0.4	" + Na ₂ SO ₄
36	0	40.3	67	0	33	Na ₂ SO ₄
"	8.8	29.2	70.6	6.8	22.6	"
"	12.8	22.4	71.2	10.5	18.3	"
"	17.0	15.4	71.1	15.5	13.4	"
"	18.1	15.3	71	15.7	13.3	"
"	28.9	5.4	66.5	28.4	5.1	"
"	48.7	0.8	50.9	48.3	0.8	"
45	0	47.9	67.6	0	32.4	"
"	9	27.5	71.3	7.1	21.6	"
"	14.5	19.2	71.8	12.1	16.1	"
"	20.6	12.3	70.6	18.4	10	"
"	31	5.1	65.6	29.5	4.9	"

The following additional determinations at 25° are given by Schreinemakers and de Baat (1909):

25	...	...	63.41	34.84	1.75	Na ₂ SO ₄ .10H ₂ O
"	...	...	49	50.5	0.5	"
"	...	...	46.6	53	0.4	" + Na ₂ SO ₄
"	...	...	34.9	64.95	0.15	Na ₂ SO ₄

Between certain concentrations of the aqueous alcohol the liquid separates into two layers. The following results were obtained at 25°, 36° and 45°:

t°.	Upper Layer.			Lower Layer		
	Gms. H ₂ O.	Gms. C ₂ H ₅ OH.	Gms. Na ₂ SO ₄ .	Gms. H ₂ O.	Gms. C ₂ H ₅ OH.	Gms. Na ₂ SO ₄ .
25	66.5	27.3	6.2	67.4	5.1	27.5
"	68.1	23.9	8.0	68.5	6.0	25.5
"	68.3	23.1	8.6	68.3	6.7	25.0
36	...	...	...	66.6	4.1	29.3
"	57.7	38.4	3.9	...	...	...
"	65.0	28.3	6.7	68.8	5.9	25.3
"	68.1	21.2	10.7	68.9	9.4	21.7
45	61.8	32.9	5.3	...	...	...
"	65.8	25.3	8.9	68.4	8.8	22.8
"	66.0	24.0	10.0	68.6	10.1	21.3

Data for equilibrium in the system Na₂SO₄ + NaCl + C₂H₅OH + H₂O at 15°, 25° and 35° are given by Schreinemakers and de Baat (1909), and Schreinemakers (1910).

SOLUBILITY OF SODIUM SULFATE IN SEVERAL ALCOHOLS.

(Kirm and Dunlap, 1931.)

Alcohol	Formula	Gm. Mols. Na_2SO_4 per 100 gm. Mols. Alcohol at:			
		20°	30°	40°	50°
Methanol	CH_3OH	0.00555	0.00544	0.00523	0.00415
Ethanol	$\text{C}_2\text{H}_5\text{OH}$	0.00143	0.00154	0.00156	0.00114
Iso Propanol	$\text{CH}_3\text{CHOHCH}_3$	0.000886	0.000939	0.000928	0.000739

Insoluble in Propanol, Butanol and Iso Butanol.

SOLUBILITY OF SODIUM SULFATE IN AQUEOUS PROPYL ALCOHOL AT 20°.

(Linebarger, 1892.)

Gms. $\text{C}_3\text{H}_7\text{OH}$ per 100 Gms. Alcohol-Water Mixture.	Gms. Na_2SO_4 per 100 Gms. Sat. Solution.	Gms. $\text{C}_3\text{H}_7\text{OH}$ per 100 Gms. Alcohol-Water Mixture.	Gms. Na_2SO_4 per 100 Gms. Sat. Solution.
42.20	1.99	56.57	0.55
49.77	1.15	60.64	0.44
55.65	0.72	62.81	0.38

100 gms. H_2O dissolve 183.7 gms. sugar + 30.5 gms. Na_2SO_4 at 31.25°, or 100 gms. sat. solution contain 52.2 gms. sugar + 9.6 gms. Na_2SO_4 . (Köhler, 1897.)

100 gms. 95% formic acid dissolve 16.5 gms. Na_2SO_4 at 19°. (Aschan, 1913.)

100 gms. of a saturated solution of $\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}$ in glycerol of 95 percent purity ($d_{25} = 1.246$) contain 7.52 gms. $\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}$ at 25°. (Schnellbach and Rosin, 1929.)

SO

EQUILIBRIUM IN THE SYSTEM SODIUM SULFATE, TERTIARY BUTYL ALCOHOL AND WATER AT 30°

(Ginnings and Robbins, 1930.)

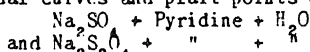
The points on the binodal curve of this system were determined by observing the appearance or disappearance of clouding in mixtures of weighed amounts of Na_2SO_4 and one of the liquids, upon addition of weighed amounts of the other. Tie lines, *, were located by determining the Na_2SO_4 in two layers in contact with each other and from these the plait point, PP., was found by plotting.

Gms. per 100 gms. homogeneous liquid		Gms. per 100 gms. homogeneous liquid		Gms. per 100 gms. homogeneous liquid		Gms. per 100 gms. homogeneous liquid	
$(\text{CH}_3)_3\text{COH}$	Na_2SO_4	$(\text{CH}_3)_3\text{COH}$	Na_2SO_4	$(\text{CH}_3)_3\text{COH}$	Na_2SO_4	$(\text{CH}_3)_3\text{COH}$	Na_2SO_4
93.0	—	37.0	2.5 PP	20.8	4.9	8.1	11.4
68.0	—	33.7	2.6	19.5	5.3	—	11.5 *
66.0	—	31.1	2.9	17.5	5.8	6.7	13.3
58.6	0.3	28.8	3.4	16.4	6.2	6.1	14.2
50.0	—	26.3	3.6	14.3	6.9	5.5	15.2
47.0	1.2	24.9	3.9	12.4	7.8	4.8	16.5
42.2	1.6	22.9	4.2	10.2	9.5	3.9	17.9
37.2	2.2	21.5	4.6 *	—	10.5 *	3.0	19.8
						1.8	24.5 *

The plait point of this system at 25° was found by Ginnings, Herring and Webb, 1933, to have the composition 2.8 percent Na_2SO_4 + 31.4 percent $(\text{CH}_3)_3\text{COH}$ + 65.8 percent H_2O .

The plait point of the System Sodium Thiosulfate, Tertiary Butyl Alcohol and Water at 25° was found by Ginnings, Herring and Webb, 1933 to have the composition, 3.2 percent $\text{Na}_2\text{S}_2\text{O}_3$ + 33.6 percent $(\text{CH}_3)_3\text{COH}$ + 63.2 percent H_2O . The original results for the other points on the binodal curve are not given but only the values of constants calculated by means of an empirical equation. Similar results for the plait point of the system Sodium Alum, Tertiary Butyl Alcohol and water at 25° are 5.4 percent $\text{NaAl}(\text{SO}_4)_2$ + 26.9 percent $(\text{CH}_3)_3\text{COH}$ + 67.7 percent H_2O .

The binodal curves and plait points of the systems



are given by Ginnings, Webb and Hinohara, 1933, but the authors do not give their experimental results but only the values of arbitrary constants calculated by means of empirical equations.

SOLUBILITY OF SODIUM SULFATE IN AQUEOUS SOLUTIONS OF URETHAN AT 25°.

(Palitzsch, 1928, 1929.)

Gms. Mols. per 1000 gms. H_2O		Solid Phase
Na_2SO_4	$\text{NH}_2\text{COOC}_2\text{H}_5$	
1.936	0.0	$\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}$
1.542	0.8273	
0.184	16.17	Upper liquid layer
1.214	1.897	Lower liquid layer

SO

SOLUBILITY OF SODIUM SULFATE IN AN AQUEOUS SOLUTION OF UREA.

(Löwenherz, 1895.)

Solvent.	t°.	Gms. Na_2SO_4 per 100 Gms. Sat. Sol.	The Corresponding Figure for the Solubility of Na_2SO_4 in Pure Water Was Found to be:
100 gms. H_2O + 12 gms. urea	20.86	22.36	...
" "	24.83	21.21	21.62
" "	28.32	26.50	26.48
" "	29.83	28.23	...
" "	31.90	...	32.34
" "	34.85	27.73	33.09
" "	39.92	27.19	32.58

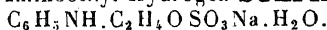
Fusion-point data for Na_2SO_4 + KCl are given by Sackur (1911-12). Results for Na_2SO_4 + SrSO_4 are given by Calcagni (1912-1912a). Results for Na_2SO_4 + Na_2WO_4 are given by Bocke (1907).

SODIUM Phenyl SULFATE $\text{C}_6\text{H}_5\text{O}_4\text{SNa} \cdot 3\text{H}_2\text{O}$.

100 gms. sat. solution in water contain 31.0 gms. of the compound at 17°.

" " alcohol " 7.0 " " (Burkhardt and Lapworth, 1926.)

SODIUM N-Phenyl β Aminoethyl Hydrogen SULFATE



100 cc. sat. solution in water contain approx. 60 gms. of the compound at 15°.

(Saunders. 1922.)

SODIUM THIOSULFATE $\text{Na}_2\text{S}_2\text{O}_3 \cdot 5\text{H}_2\text{O}(\text{I})$.

SOLUBILITY IN WATER. (Young and Burke, 1904, 1906.)

t°	Gms. $\text{Na}_2\text{S}_2\text{O}_3$ per 100 Gms.		Solid Phase.	t°	Gms. $\text{Na}_2\text{S}_2\text{O}_3$ per 100 Gms.		Solid Phase.
	Sat. Sol.	Water.			Sat. Sol.	Water.	
0	33.40	50.15	$\text{Na}_2\text{S}_2\text{O}_3 \cdot 5\text{H}_2\text{O}(\text{I})$	0	60.47	153	$\text{Na}_2\text{S}_2\text{O}_3 \cdot \text{H}_2\text{O}(\text{II})$
10	37.37	59.66	"	10	61.04	156.7	"
20	41.20	70.07	"	20	62.11	163.9	"
25	43.15	75.90	"	25	62.73	168.3	"
35	47.71	91.24	"	30	63.56	174.4	"
45	55.33	123.87	"	40	65.22	187.6	"
48.17*	...	...	" + $\text{Na}_2\text{S}_2\text{O}_3 \cdot 2\text{H}_2\text{O}(\text{I})$	50	66.82	201.4	"
0	52.73	111.60	$\text{Na}_2\text{S}_2\text{O}_3 \cdot 2\text{H}_2\text{O}(\text{I})$	56.5*	...	...	" + $\text{Na}_2\text{S}_2\text{O}_3$
10	53.94	117.10	"	0	46.14	85.67	$\text{Na}_2\text{S}_2\text{O}_3 \cdot 6\text{H}_2\text{O}(\text{III and IV})$
20	55.15	122.68	"	10	51.66	106.8	"
25	56.03	127.43	"	13	54.96	122	"
30	57.13	138.84	"	14.35*	...	...	" + $\text{Na}_2\text{S}_2\text{O}_3 \cdot \frac{1}{2}\text{H}_2\text{O}(\text{IV})$
40	59.38	146.20	"	14.3*	...	...	" + $\text{Na}_2\text{S}_2\text{O}_3 \cdot 7\text{H}_2\text{O}(\text{III})$
50	62.28	165.11	"	0	57.42	134.8	$\text{Na}_2\text{S}_2\text{O}_3 \cdot 7\text{H}_2\text{O}(\text{III})$
60	65.68	191.30	"	10	58.28	139.7	"
66.5*	...	...	" + $\text{Na}_2\text{S}_2\text{O}_3$	20	59.28	145.6	"
0	41.96	72.30	$\text{Na}_2\text{S}_2\text{O}_3 \cdot 5\text{H}_2\text{O}(\text{II})$	25	60.18	151.1	"
10	45.25	82.65	"	30	60.78	155	"
20	49.38	97.55	"	40	62.60	167.4	"
25	52.15	108.98	"	47.5	64.68	183.1	"
30	56.57	130.26	"	48.5*	...	...	" + $\text{Na}_2\text{S}_2\text{O}_3 \cdot \text{H}_2\text{O}(\text{III})$
30.22*	...	...	" + $\text{Na}_2\text{S}_2\text{O}_3 \cdot 4\text{H}_2\text{O}(\text{II})$	47.5	64.78	183.9	$\text{Na}_2\text{S}_2\text{O}_3 \cdot \text{H}_2\text{O}(\text{III})$
33.5	58.59	141.48	$\text{Na}_2\text{S}_2\text{O}_3 \cdot 4\text{H}_2\text{O}(\text{II})$	50	65.3	188.2	"
36.2	60.51	153.23	"	55	66.45	198.1	"
36.6	62.80	168.82	"	60	68.07	213.1	"
40.65*	...	..	" + $\text{Na}_2\text{S}_2\text{O}_3 \cdot \text{H}_2\text{O}(\text{II})$	61*	...	...	" + $\text{Na}_2\text{S}_2\text{O}_3$

* tr. pt.

t°	Gms. $\text{Na}_2\text{S}_2\text{O}_3$ per 100 Gms.		Solid Phase.	t°	Gms. $\text{Na}_2\text{S}_2\text{O}_3$ per 100 Gms.		Solid Phase.
	Sat. Sol.	Water.			Sat. Sol.	Water.	
0	57.63	136	$\text{Na}_2\text{S}_2\text{O}_3 \cdot \frac{1}{2}\text{H}_2\text{O}(\text{IV})$	30	63.34	172.80	$\text{Na}_2\text{S}_2\text{O}_3 \cdot \text{H}_2\text{O}(\text{V})$
10	58.49	140.9	"	40	64.75	183.70	"
20	59.57	147.3	"	50	66.58	199.2	"
25	60.35	152.2	"	55	67.59	208.5	"
30	61.03	156.6	"	43*	...	...	" + $\text{Na}_2\text{S}_2\text{O}_3 \cdot \frac{1}{2}\text{H}_2\text{O}(\text{V})$
40	62.95	169.9	"	25	64.21	179.4	$\text{Na}_2\text{S}_2\text{O}_3 \cdot \frac{1}{2}\text{H}_2\text{O}(\text{V})$
50	65.45	189.5	"	40	64.99	185.6	"
55	67.07	203.7	"	50	66.02	194.3	"
58*	...	...	" + $\text{Na}_2\text{S}_2\text{O}_3$	60	67.4	206.7	"
0	57.63	136	$\text{Na}_2\text{S}_2\text{O}_3 \cdot 2\text{H}_2\text{O}(\text{V})$	70	69.06	223.2	"
10	59.05	144.2	"	70*	...	...	" + $\text{Na}_2\text{S}_2\text{O}_3$
20	61.02	156.5	"	40	67.4	206.7	$\text{Na}_2\text{S}_2\text{O}_3$
25	62.30	165.3	"	50	67.76	210.2	"
30	63.56	174.4	"	60	68.48	217.3	"
35	65.27	188	"	70	69.05	223.1	"
27.5*	...	...	" + $\text{Na}_2\text{S}_2\text{O}_3 \cdot \text{H}_2\text{O}(\text{V})$	80	69.86	231.8	"

* tr. pt.

The authors adopted a new system of naming the hydrates, based upon their mutual transition relations. These transitions occur in such a way that the members of one group undergo transition into members of the same group and not into members of another group. Those hydrates belonging to group (I) are called primary hydrates, those belonging to group (II) are called secondary and those belonging to the (III), (IV) and (V) groups are called tertiary, quaternary and quintary respectively.

Commercial sodium thiosulfate is the primary pentahydrate, $\text{Na}_2\text{S}_2\text{O}_3 \cdot 5\text{H}_2\text{O}(\text{I})$.

SODIUM THIOSULFATE $\text{Na}_2\text{S}_2\text{O}_3 \cdot 5\text{H}_2\text{O}$ (I).

SOLUBILITY OF SODIUM THIOSULFATE IN WATER. (Picon, 1924.)

This entire system has been reinvestigated by a method of determination involving the reheating of previously crystallized mixtures of accurately weighed amounts of the constituents, and observing the temperature of disappearance of the last crystal. The results are, with few exceptions, in very good agreement with the determinations of Young and Burke, 1904, 1906 (« Solubilities », page 674-675) made by the direct analysis of saturated solutions. The present results are given in terms of gram molecules of $\text{Na}_2\text{S}_2\text{O}_3$ per 100 gram. molecules of the mixture.

t°. Mol. % $\text{Na}_2\text{S}_2\text{O}_3$.	t°. Mol. % $\text{Na}_2\text{S}_2\text{O}_3$.	t°. Mol. % $\text{Na}_2\text{S}_2\text{O}_3$.	t°. Mol. % $\text{Na}_2\text{S}_2\text{O}_3$.
Ice Curve.	$\text{Na}_2\text{S}_2\text{O}_3 \cdot 10\text{H}_2\text{O}$ (I) Curve.	$\text{Na}_2\text{S}_2\text{O}_3 \cdot 5\text{H}_2\text{O}$ (II) Curve.	$\text{Na}_2\text{S}_2\text{O}_3 \cdot 5\text{H}_2\text{O}$ (I) Curve.
— 1.8... 0.85	— 10.5... 6.56	— 14.0... 6.34	9.75... 6.23
— 4.3... 2.09	— 9.5... 7.0	— 9.0... 6.56	12.7... 6.43
— 6.8... 3.40	— 9.0... 7.25	— 2.0... 7.03	15.7... 6.87
— 8.6... 4.14	— 8.6... 7.49	+ 2.5... 7.56	18.4... 7.01
— 10.0... 4.50	— 8.2... 8.02	5.4... 7.98	23.1... 7.64
— 10.6... 4.71	— 7.9... 8.45	14.5... 8.98	25.8... 8.02
— 14.0... 5.70		20.8... 10.00	31.0... 8.59
— 17.5... 6.56	$\text{Na}_2\text{S}_2\text{O}_3 \cdot 6\text{H}_2\text{O}$ (II) Curve.	25.5... 10.98	37.6... 9.68
— 22.5... 7.25	— 16.0... 6.24	28.1... 11.92	41.5... 10.97
$\text{Na}_2\text{S}_2\text{O}_3 \cdot 12\text{H}_2\text{O}$ (II) Curve.	— 13.0... 6.56	30.1... 13.01	45.5... 12.50
— 16.5... 7.49	— 9.5... 7.00	$\text{Na}_2\text{S}_2\text{O}_3 \cdot 5\text{H}_2\text{O}$ (I) Curve.	46.9... 13.46
— 16.3... 8.02	— 3.0... 8.02	— 4.8... 4.92	47.8... 14.28
$\text{Na}_2\text{S}_2\text{O}_3 \cdot 10\text{H}_2\text{O}$ (I) Curve.	— 0.5... 8.45	— 3.4... 4.94	48.2... 15.72
— 13.9... 6.01	+ 3.4... 9.00	— 1.0... 5.21	48.3... 16.55
— 11.5... 6.34	8.0... 10.00	+ 3.6... 5.66	48.6... 17.35
	12.9... 11.92	4.5... 5.73	48.0... 17.80
		8.5... 6.02	48.0... 18.15
t°. Mol. % $\text{Na}_2\text{S}_2\text{O}_3$.	t°. Mol. % $\text{Na}_2\text{S}_2\text{O}_3$.	t°. Mol. % $\text{Na}_2\text{S}_2\text{O}_3$.	t°. Mol. % $\text{Na}_2\text{S}_2\text{O}_3$.
$\text{Na}_2\text{S}_2\text{O}_3 \cdot 4\text{H}_2\text{O}$ (II) Curve.	$\text{Na}_2\text{S}_2\text{O}_3 \cdot \text{H}_2\text{O}$ (II) Curve.	$\text{Na}_2\text{S}_2\text{O}_3 \cdot \text{H}_2\text{O}$ (I) Curve.	$\text{Na}_2\text{S}_2\text{O}_3$ Curve.
34.9... 14.23	52.5... 18.10	60.5... 20.06	61.0... 19.69
37.9... 15.00	59.0... 19.20	61.7... 20.22	61.7... 19.72
39.0... 16.05	59.5... 19.34	63.7... 20.64	67.0... 19.90
40.0... 16.74	61.4... 19.75	65.0... 20.84	68.0... 19.94
40.1... 17.23	62.4... 19.84	70.0... 21.86	68.5... 19.96
$\text{Na}_2\text{S}_2\text{O}_3 \cdot 2\text{H}_2\text{O}$ (I) Curve.	63.5... 20.19	71.5... 22.17	69.5... 19.98
49.6... 15.57	65.4... 20.48	72.0... 22.26	69.8... 20.08
56.7... 16.81	66.5... 20.79	72.5... 22.45	74.0... 20.22
59.0... 17.40	66.8... 20.86	$\text{Na}_2\text{S}_2\text{O}_3 \cdot 1\frac{1}{2}\text{H}_2\text{O}$ (I) Curve.	74.6... 20.29
61.3... 18.23	67.5... 21.17	59.5... 18.77	76.5... 20.42
62.3... 18.30	69.1... 21.39	63.5... 19.06	79.75... 20.48
64.9... 19.20	69.5... 21.64	65.0... 19.32	83.0... 20.80
65.0... 19.20	$\text{Na}_2\text{S}_2\text{O}_3 \cdot \text{H}_2\text{O}$ (I) Curve.	66.5... 19.40	88.0... 20.97
65.5... 19.40	45.6... 17.92	67.2... 19.44	91.0... 21.19
66.0... 19.51	49.5... 18.49	69.5... 19.75	93.5... 21.30
66.5... 19.68	51.5... 18.62	70.0... 19.80	97.0... 21.58
66.8... 19.71	53.5... 19.05	72.0... 20.07	107.0... 22.32
$\text{Na}_2\text{S}_2\text{O}_3 \cdot \text{H}_2\text{O}$ (II) Curve.	55.5... 19.33	75.0... 20.44	112.0... 22.60
46.2... 17.06	57.5... 19.61	76.0... 20.72	112.5... 22.69
51.9... 18.08	59.0... 19.84	88.0... 22.26	114.5... 22.91

100 gms. alcohol dissolve 0.0025 gm. $\text{Na}_2\text{S}_2\text{O}_3$ and 0.0034 gm. $\text{Na}_2\text{S}_2\text{O}_3 \cdot 5\text{H}_2\text{O}$ at room temperature. (Bödtker, 1897.)

100 gms. alcohol of 0.941 Sp. Gr. dissolve 33.3 gms. sodium thiosulfate at 15.5° .

Data for the lowering of the freezing-point of $\text{Na}_2\text{S}_2\text{O}_3 \cdot 5\text{H}_2\text{O}$ by each of the following compounds: urea, glucose, cane sugar, NaCl , NaClO_3 , NaNO_3 and Na_2SO_4 are given by Boutaric (1911).

EQUILIBRIUM IN THE SYSTEM SODIUM THIOSULFATE, ETHYL ALCOHOL AND WATER AT 20° .

(Dollé, 1934.)

Results determined by analysis of saturated solutions prepared by shaking together $\text{Na}_2\text{S}_2\text{O}_3 \cdot 5\text{H}_2\text{O}$, and aqueous ethyl alcohol solutions containing various concentrations of $\text{C}_2\text{H}_5\text{OH}$ by volume.

Vol. percent $\text{C}_2\text{H}_5\text{OH}$ in solvent used	Volume of liquid layers	d. of liquid layers	Gms. per 100 gms. liquid layer	
			$\text{Na}_2\text{S}_2\text{O}_3$	$\text{C}_2\text{H}_5\text{OH}$
10 (no separation)	1	1.344	36.70	4.0
20 { Upper layer	7.9 cc	0.876	1.2	50.31
20 { Lower layer	92.1 "	1.338	36.9	5.2
30 { Upper layer	21.6 "	0.899	1.128	51.6
30 { Lower layer	78.4 "	1.338	36.90	4.8
40 { Upper layer	34.8 "	0.901	1.15	53.17
40 { Lower layer	65.2 "	1.337	36.85	4.3
50 { Upper layer	52.8 "	0.898	1.10	56.7
50 { Lower layer	47.2 "	1.342	36.85	4.3
60 { Upper layer	73.8 "	0.898	1.02	56.9
60 { Lower layer	26.2 "	1.341	36.85	4.3
70 (no separation)		0.895	0.967	62.0
80 " "		0.864	0.230	73.5
90 " "		0.834	0.0146	85.7

Results determined by the sythetic method; that is by titrating known aqueous solutions of thiosulfate with known amounts of alcohol to appearance of clouding.

Gms. per 100 gms. homogeneous mixture			Gms. per 100 gms. homogeneous mixture		
$\text{Na}_2\text{S}_2\text{O}_3$	H_2O	$\text{C}_2\text{H}_5\text{OH}$	Na_2SO_4	H_2O	$\text{C}_2\text{H}_5\text{OH}$
28.31	62.85	8.83	4.85	53.37	41.76
24.82	63.0	11.87	3.90	51.10	45.00
16.77	61.64	21.59	3.18	40.22	47.60
7.73	57.23	35.04	1.93	43.81	54.26
6.72	55.96	37.18	0.93	36.56	62.51
6.10	55.44	38.46	0.92	31.94	67.12
5.84	54.76	39.40	0.41	29.00	70.58

The binodal curves and plait points of the systems:

Sodium Thiosulfate + Allyl Alcohol + Water at 25°
and Sodium Thiosulfate + Pyridine + Water at 25° have been determined respectively by Ginnings and Dees, 1935, and Ginnings, Webb and Hinohara, 1933, but the experimental results are not given but only the values of a series of constants calculated by empirical equations.

An aqueous solution simultaneously saturated with Sodium Thiosulfate and Urethan, contains 4.79 gm. mols. $\text{Na}_2\text{S}_2\text{O}_3 + 0.132$ gm. mols. $\text{NH}_2\text{COOC}_2\text{H}_5$ per 1000 gms. H_2O at 25° . (Palitzsch, 1928, 1929.)

SODIUM Di THIONATE $\text{Na}_2\text{S}_2\text{O}_6 \cdot 2\text{H}_2\text{O}$.

SOLUBILITY OF SODIUM DI THIONATE IN WATER.

(Tahikawa and Oku, 1927.)

t°	d. of sat. sol.	Gms. $\text{Na}_2\text{S}_2\text{O}_6$ per 100 gms. H_2O	Solid Phase	t°	d. of sat. sol.	Gms. $\text{Na}_2\text{S}_2\text{O}_6$ per 100 gms. H_2O	Solid Phase
-1.36	—	5.72	$\text{Na}_2\text{S}_2\text{O}_6 \cdot 8\text{H}_2\text{O}$	5	—	9.34*	$\text{Na}_2\text{S}_2\text{O}_6 \cdot 2\text{H}_2\text{O}$
-0.73	—	5.94	"	10	1.0773	11.12	"
-0.49	—	6.04	"	20	1.0984	15.12	"
0.0	—	6.27	" + $\text{Na}_2\text{S}_2\text{O}_6 \cdot 6\text{H}_2\text{O}$	30	1.1216	19.63	"
+1.0	—	6.62	$\text{Na}_2\text{S}_2\text{O}_6 \cdot 6\text{H}_2\text{O}$	40	1.1460	24.69	"
3.0	1.054	7.49	"	50	1.1705	30.17	"
5.0	1.056	8.47	"	60	1.1920	36.07	"
7.5	1.068	9.82	"	70	1.2191	42.48	"
9.1	—	10.80	" + $\text{Na}_2\text{S}_2\text{O}_6 \cdot 2\text{H}_2\text{O}$	80	1.2425	49.26	"
10.0	—	11.34*	"	90	1.2711	56.29	"
0	1.0565	7.83*	$\text{Na}_2\text{S}_2\text{O}_6 \cdot 2\text{H}_2\text{O}$	100	1.2981	64.74	"

* Metastable.

100 gms. sat. solution of sodium dithionate in water contain 6.05 gms. $\text{Na}_2\text{S}_2\text{O}_6$ at 0° , 10.63 gms. at 12° , 13.39 gms at 20° and 17.32 gms. at 30° . (de Baat, 1926.)

SOLUBILITY OF SODIUM DITHIONATE IN AQUEOUS SOLUTIONS

OF STRONTIUM DITHIONATE AT 30° AND VICE VERSA. (de Baat, 1926.)

Gms. per 100 gms. sat. sol.		Solid Phase.	Gms. per 100 gms. sat. sol.		Solid Phase.
$\text{Na}_2\text{S}_2\text{O}_6$	SrS_2O_6		$\text{Na}_2\text{S}_2\text{O}_6$	SrS_2O_6	
17.32	0.0	$\text{Na}_2\text{S}_2\text{O}_6 \cdot 2\text{H}_2\text{O}$	6.91	12.24	$\text{SrS}_2\text{O}_6 \cdot 4\text{H}_2\text{O}$
14.52	5.55	"	0.0	14.90	"
13.06	10.09	" + $\text{SrS}_2\text{O}_6 \cdot 4\text{H}_2\text{O}$			

SODIUM Poly THIONATE Tri ($\text{Na}_2\text{S}_3\text{O}_6 \cdot 3\text{H}_2\text{O}$; Tetra ($\text{Na}_2\text{S}_4\text{O}_6 \cdot 2\text{H}_2\text{O}$) Penta ($\text{Na}_2\text{S}_5\text{O}_6 \cdot 2\text{H}_2\text{O}$)

SO

EQUILIBRIUM IN THE SYSTEM SODIUM TRI THIONATE, SODIUM TETRA THIONATE AND WATER.

(Kurtanacker and Lasslo, 1938.)

Results at 0°

Results at 20°

Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.			Solid Phase
$\text{Na}_2\text{S}_3\text{O}_6$	$\text{Na}_2\text{S}_4\text{O}_6$		$\text{Na}_2\text{S}_3\text{O}_6$	$\text{Na}_2\text{S}_4\text{O}_6$	$\text{Na}_2\text{S}_5\text{O}_6$	
37.8	0.0	S_3	52.9	0.0	0.0	S_3
37.6	0.4	"	52.2	0.6	0.0	"
36.6	3.9	"	46.7	6.4	0.4	"
36.7	5.6	"	43.1	12.7	0.7	"
34.4	16.2	"	40.0	17.8	1.1	"
32.8	20.8	" + S_4	38.8	19.3	1.6	" + S_4
30.9	21.0	S_4	34.0	21.6	2.8	S_4
28.6	22.4	"	25.3	27.3	2.2	"
20.6	26.9	"	21.3	30.5	3.4	"
16.6	28.2	"	12.1	37.9	2.3	"
11.9	33.7	"	9.8	40.4	3.2	"
2.9	39.8	"	5.1	45.8	2.0	"
0.0	41.3	"	1.4	49.7	0.5	"
59.0 (30°)	0.0	S_8	0.0	50.4	—	"
			0.0	55.0 (30°)	—	"

$\text{S}_3 = \text{Na}_2\text{S}_3\text{O}_6 \cdot 3\text{H}_2\text{O}$; $\text{S}_4 = \text{Na}_2\text{S}_4\text{O}_6 \cdot 2\text{H}_2\text{O}$.

Na NATRIUM

SODIUM Poly THIONATES

1320

EQUILIBRIUM IN THE SYSTEM SODIUM TETRA THIONATE, SODIUM PENTA THIONATE AND WATER.

(Kurtenacker and Lasso, 1938.)

Results at 0°

Results at 20°

Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase
$\text{Na}_2\text{S}_4\text{O}_6$	$\text{Na}_2\text{S}_5\text{O}_6$		$\text{Na}_2\text{S}_4\text{O}_6$	$\text{Na}_2\text{S}_5\text{O}_6$	
27.8	12.5	$\text{Na}_2\text{S}_4\text{O}_6 \cdot 2\text{H}_2\text{O}$	44.0	8.8	$\text{Na}_2\text{S}_4\text{O}_6 \cdot 2\text{H}_2\text{O}$
23.5	17.9	"	34.6	10.9	"
22.5	19.8	" + $\text{Na}_2\text{S}_5\text{O}_6 \cdot 2\text{H}_2\text{O}$	33.0	13.3	"
17.5	21.2	$\text{Na}_2\text{S}_5\text{O}_6 \cdot 2\text{H}_2\text{O}$	28.0	19.6	"
14.8	22.1	"	25.2	23.3	" + $\text{Na}_2\text{SO}_4 \cdot 2\text{H}_2\text{O}$
6.5	27.2	"	21.4	23.2	$\text{Na}_2\text{S}_5\text{O}_6 \cdot 2\text{H}_2\text{O}$
4.5	29.2	"	15.3	29.8	"
0.0	32.9	"	1.9	49.2	"
			0.0	52.0	"

SODIUM Dihydro Pyro ANTIMONATE $\text{Na}_2\text{H}_2\text{Sb}_2\text{O}_7$.

100 gms. sat. solution of Sodium Dihydro Pyro Antimonate in Water contain 0.0564 gms. $\text{Na}_2\text{H}_2\text{Sb}_2\text{O}_7$ at 18°, 0.0738 gm. at 25° and 0.1018 gm. at 33.5°. (Tomula, 1921.)

SODIUM SulfoANTIMONATE $\text{Na}_3\text{SbS}_4 \cdot 9\text{H}_2\text{O}$.

SOLUBILITY IN WATER

(Donk, 1908.)

SbS

Gms. Na_3SbS_4 per 100 Gms. Sat. Sol.			Gms. Na_3SbS_4 per 100 Gms. Sat. Sol.			Gms. Na_3SbS_4 per 100 Gms. Sat. Sol.		
t°.		Solid Phase.	t°.		Solid Phase.	t°.		Solid Phase.
-0.1	0.5	Ice	-1.75	11.2	Ice	49.6	38.9	$\text{Na}_3\text{SbS}_4 \cdot 9\text{H}_2\text{O}$
-0.65	4	"	0	11.8	$\text{Na}_3\text{SbS}_4 \cdot 9\text{H}_2\text{O}$	59.6	45	"
-0.9	5.7	"	15	19.3	"	69.6	50.7	"
-1.26	7.8	"	30	27.1	"	79.5	57.1	"
-1.45	9.2	"	38	32	"			

SOLUBILITY OF SODIUM SULFOANTIMONATE IN AQUEOUS SOLUTIONS OF SODIUM HYDROXIDE AT 30°.

(Donk, 1908.)

Gms. per 100 Gms. Sat. Sol.		Solid Phase.	Gms. per 100 Gms. Sat. Sol.		Solid Phase.
Na_3SbS_4	NaOH		Na_3SbS_4	NaOH	
27.1	0	$\text{Na}_3\text{SbS}_4 \cdot 9\text{H}_2\text{O}$	16.4	42.6	$\text{Na}_3\text{SbS}_4 \cdot 9\text{H}_2\text{O}$
13	9.9	"	17.7	47.2	" + $\text{NaOH} \cdot \text{H}_2\text{O}$
5.9	24.8	"	9.1	49.5	$\text{NaOH} \cdot \text{H}_2\text{O}$
10.5	32.9	"	0	54.3	

SOLUBILITY OF SODIUM SULFOANTIMONATE IN AQUEOUS SOLUTIONS OF SODIUM THIOSULFATE.

(Donk, 1908.)

Results at 0°.			Results at 30°.		
Gms. per 100	Gms. Sat. Sol.	Solid Phase.	Gms. per 100	Gms. Sat. Sol.	Solid Phase.
Na_3SbS_4 .	$\text{Na}_2\text{S}_2\text{O}_3$.		Na_3SbS_4 .	$\text{Na}_2\text{S}_2\text{O}_3$.	
11.8	0	$\text{Na}_3\text{SbS}_4 \cdot 9\text{H}_2\text{O}$	19.9	7.7	$\text{Na}_3\text{SbS}_4 \cdot 9\text{H}_2\text{O}$
4.4	4.9	"	12.5	16.4	"
0.8	14.6	"	4.2	37.7	"
0.1	27.3	"	1	43.8	"
0	33.6	" + $\text{Na}_2\text{S}_2\text{O}_3 \cdot 5\text{H}_2\text{O}$	1	47	"
0	33.6	$\text{Na}_2\text{S}_2\text{O}_3 \cdot 5\text{H}_2\text{O}$	1	47.8	" + $\text{Na}_2\text{S}_2\text{O}_3 \cdot 5\text{H}_2\text{O}$
			0	45.8	$\text{Na}_2\text{S}_2\text{O}_3 \cdot 5\text{H}_2\text{O}$

SOLUBILITY OF SODIUM SULFOANTIMONATE IN AQUEOUS ETHYL ALCOHOL.

(Donk, 1908.)

Results at 0°.		Results at 30°.		Results at 65°.	
Gms. per 100	Gms. Sat. Sol.	Gms. per 100	Gms. Sat. Sol.	Gms. per 100	Gms. Sat. Sol.
Na_3SbS_4 .	$\text{C}_2\text{H}_5\text{OH}$.	Na_3SbS_4 .	$\text{C}_2\text{H}_5\text{OH}$.	Na_3SbS_4 .	$\text{C}_2\text{H}_5\text{OH}$.
11.8	0	19.3	5	47.9	0
8.2	3.7	14.6	10.3	39.3	4.7
3.2	12.7	6.4	24.8	36.5	8*
0.9	29	1.2	46	4.1	54.1*
0	60.8	0	76.2	0	81

* Two liquid layers separate between these concentrations of alcohol. The composition of several of these conjoined layers is as follows:

Gms. per 100 Gms. Alcoholic Layer.		Gms. per 100 Gms. Aqueous Layer.	
Na_3SbS_4 .	$\text{C}_2\text{H}_5\text{OH}$.	Na_3SbS_4 .	$\text{C}_2\text{H}_5\text{OH}$.
4.1	54.1	36.5	8
10.2	40.4	27.8	14.3
14.1	33.5	24.1	18.8
...	0	18	27.2

The solid phase in contact with each of the above solutions is $\text{Na}_3\text{SbS}_4 \cdot 9\text{H}_2\text{O}$.

SOLUBILITY OF SODIUM SULFOANTIMONATE IN AQUEOUS METHYL ALCOHOL.

(Donk, 1908.)

Results at 0°.		Results at 30°.	
Gms. per 100	Gms. Sat. Sol.	Gms. per 100	Gms. Sat. Sol.
Na_3SbS_4 .	CH_3OH .	Na_3SbS_4 .	CH_3OH .
8.6	3.4	27.1	0
2.8	15.5	12.8	18.1
2.1	23.1	5.8	33.1
0.3	50.3	0.1	65.7
0.1	57	0.1	84.2
0.05	81.7	1.2	91.2
0.2	92	3.9	94
2	95.9		

SbS

Na NATRIUM

1322

SODIUM SELENITE $\text{Na}_2\text{SeO}_3 \cdot 5\text{H}_2\text{O}$.

SOLUBILITY OF SODIUM SELENITE IN WATER.

(Janitzki, 1932.)

t°	Gms. Na_2SeO_3 per 100 gms. sat. sol.	Solid Phase	t°	Gms. Na_2SeO_3 per 100 gms. sat. sol.	Solid Phase
-20.5	38.8	Ice + $\text{Na}_2\text{SeO}_3 \cdot 8\text{H}_2\text{O}$	+16.3	45.48	$\text{Na}_2\text{SeO}_3 \cdot 5\text{H}_2\text{O}$
-15	40.0		19.5	46.12	"
-10	41.58		24.4	47.28	"
-8.7	—	" + $\text{Na}_2\text{SeO}_3 \cdot 5\text{H}_2\text{O}$	30.4	48.27	"
-8.0	42.9*		34.7	49.40	"
-28.1	41.6*	Ice + $\text{Na}_2\text{SeO}_3 \cdot 5\text{H}_2\text{O}$	40.5	50.90*	"
-20.6	41.88*		35.9	—	" + Na_2SeO_3
-15	42.11*	"	46.8	48.76	Na_2SeO_3
-10.5	42.13*	"	54.4	48.14	"
-6.8	42.4	"	67.6	47.15	"
-0.5	43.9	"	89.1	45.93	"
			103.3	45.30	"

In a later paper Janickis and Gutmanite, 1936, give results for the freezing-points of aqueous solutions of $\text{Na}_2\text{SeO}_3 \cdot 8\text{H}_2\text{O}$.

SODIUM Acid SELENITES $\text{Bi}(\text{NaHSeO}_3 \cdot 3\text{H}_2\text{O})$, Pyro ($\text{Na}_2\text{Se}_2\text{O}_5$).

SOLUBILITY OF SODIUM ACID SELENITES IN WATER.

(Janitzki, 1932.)

SeO

t°	Gms. $\text{Na}_2\text{Se}_2\text{O}_5$ per 100 gms. sat. sol.	Solid Phase	t°	Gms. $\text{Na}_2\text{Se}_2\text{O}_5$ per 100 gms. sat. sol.	Solid Phase
-9.3	31.66 (33.66)	Ice + $\text{NaHSeO}_3 \cdot 3\text{H}_2\text{O}$	40.1	64.27	NaHSeO_3
0	38.45		50.0	65.98	"
+8.1	43.97	"	59.9	67.40	"
14.6	49.19	"	79.2	72.26	"
20.0	54.02	"	89.0	74.76	"
25.4	60.32	"	93.0	75.8	" + $\text{Na}_2\text{Se}_2\text{O}_5$
27.1	62.52	" + NaHSeO_3	96	76.05	$\text{Na}_2\text{Se}_2\text{O}_5$
28.8	62.88	NaHSeO_3	101.4	76.61	"
32.0	63.14	"	109.5	77.57	"

The freezing-points of aqueous solutions of $\text{NaHSeO}_3 \cdot 3\text{H}_2\text{O}$ are given by Janickis and Gutmanite, 1936.

SODIUM Tetra SELENITE $\text{NaH}_3(\text{SeO}_3)_2$.

SOLUBILITY OF SODIUM TETRA SELENITE IN WATER.

(Janitzki, 1932.)

t°	Gms. $\text{NaH}_3(\text{SeO}_3)_2$ per 100 gms. sat. sol.	Solid Phase	t°	Gms. NaH_3SeO_3 per 100 gms. sat. sol.	Solid Phase
-7.5	36.5	Ice + NaH_3SeO_3	32.0	58.17	NaH_3SeO_3
-6.9	37.12		51.3	67.42	"
-0.7	41.50	"	69.6	75.88	"
13.5	48.83	"	79.2	80.93	"
22.8	53.42	"	83.0	83.95	"

The freezing-points of aqueous solutions of $\text{NaH}_3(\text{SeO}_3)_2$ are given by Janickis and Gutmanite, 1936.

SODIUM SELENATE $\text{Na}_2\text{SeO}_4 \cdot 10\text{H}_2\text{O}$.

SOLUBILITY IN WATER. (Funk, 1900a.)

t°.	Gms. Na_2SeO_4 per 100 Gms. Solution.	Mols. Na_2SeO_4 per 100 Mols. H_2O .	Solid Phase.	t°	Gms. Na_2SeO_4 per 100 Gms. Solution.	Mols. Na_2SeO_4 per 100 Mols. H_2O .	Solid Phase.
0	11.74	1.26	$\text{Na}_2\text{SeO}_4 \cdot 10\text{H}_2\text{O}$	35.2	45.47	7.94	Na_2SeO_4
15.	25.01	3.18	"	39.5	45.26	7.87	"
18	29.00	3.90	"	50	44.49	7.63	"
25.2	36.91	5.57	"	75	42.83	7.14	"
27	39.18	6.13	"	100	42.14	6.93	"
30	44.05	7.50	"				

Sp. Gr. of saturated solution at 18° = 1.315.

The above results were confirmed by Meyer and Aulich, 1928, and the transition point of $\text{Na}_2\text{SeO}_4 \cdot 10\text{H}_2\text{O} \rightarrow \text{Na}_2\text{SeO}_4$ found to be at 31.8°.

The following results for the solubility of Na_2SeO_4 in water at temperatures above 75° are given by Smits and Mazée, 1928.)

t°	Gms. Na_2SeO_4 per 100 gms. sat. sol.	Gm. Mols. percent Na_2SeO_4 in sat. sol.	t°	Gms. Na_2SeO_4 per 100 gms. sat. sol.	Gm. Mols. percent Na_2SeO_4 in sat. sol.
76	43.0	6.7	269	42.6	6.6
86	42.2	6.5	274	43.0	6.7
107	41.8	6.4	333	46.1	7.6
232	41.8	6.4	372	48.7	8.3
262	42.2	6.5	777 m.p.	100.0	100

SODIUM Neodymium SELENATE $\text{NaNd}(\text{SeO}_4)_2 \cdot 2\text{H}_2\text{O}$.

100 gms. H_2O dissolve about 7 gms. of the salt (? anhydrous) at 0° and 7 gms. at 20°. (Meyer, Julius and Kittlemann, 1931.)

SODIUM SILICATE $\text{Na}_2\text{SiO}_3 \cdot 9\text{H}_2\text{O}$.

SOLUBILITY IN AQUEOUS SODIUM HYDROXIDE AND SODIUM CHLORIDE SOLUTIONS. (Vesterberg, 1912.)

Solvent.	t°.	d_{17} of Sat. Sol.	Gms. per 100 cc. Sat. Solution.			
			Na_2O .	$\text{SiO}_2 = \text{Na}_2\text{SiO}_3 \cdot 9\text{H}_2\text{O}$.	NaCl .	
Approx. 0.5 n NaOH	17.5	1.129	6.942	5.419	25.56	...
" " NaCl	17.5	1.150	7.347	7.172	33.83	2.297
Saturated NaCl Solution	19	1.258	4.563	4.376	20.64	27.91

Solid phase $\text{Na}_2\text{SiO}_3 \cdot 9\text{H}_2\text{O}$ in each case.

Na NATRIUM SODIUM SILICATE

1324

EQUILIBRIUM IN THE SYSTEM SODIUM OXIDE, SILICA AND WATER AT 25°.
(Harman, 1927.)

The mixtures composed of Na_2SiO_3 , $\text{Na}_2\text{O} \cdot 2\text{SiO}_2$, $\text{Na}_2\text{O} \cdot 3\text{SiO}_2$, silicate solutions, caustic soda and water, were stirred in hard glass vessels while protected from the CO_2 of the atmosphere, for periods of 8-14 days. In the cases of the saturated solutions too viscous to be filtered the clearest portions were centrifuged for a couple of days and the almost but still slightly cloudy supernatant solution used for analysis. Solutions having a composition of $\text{Na}_2\text{O}:\text{SiO}_2$ in excess of the ration 1:3 set to gels which could be moulded into elastic balls.

Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase
Na_2O	SiO_2		Na_2O	SiO_2	
53.45	—	$\text{NaOH} \cdot \text{H}_2\text{O}$	13.70	1.19	$\text{Na}_2\text{SiO}_3 \cdot 9\text{H}_2\text{O}$
44.78	0.85	Na_2SiO_3	9.45	2.22	"
36.39	0.44	"	9.37	8.74	"
35.54	2.94	$\text{Na}_2\text{SiO}_3 \cdot 2\frac{1}{2}\text{H}_2\text{O}$	14.11	19.65	"
33.02	2.92	$\text{Na}_2\text{SiO}_3 \cdot 6\text{H}_2\text{O}$	19.32	31.33	"
29.58	1.90	"	18	33	$\text{Na}_2 \cdot 2\text{SiO}_2 \cdot 9\text{H}_2\text{O}$
27.54	1.84	"	10.52	28.8	"
24.48	1.34	$\text{Na}_2\text{SiO}_3 \cdot 9\text{H}_2\text{O}$	11.0	38	"

Due to experimental difficulties the results for $\text{Na}_2\text{O} \cdot 2\text{SiO}_2 \cdot 9\text{H}_2\text{O}$ are of uncertain accuracy.

Fusion-point data for $\text{Na}_2\text{SiO}_3 + \text{SrSiO}_3$ are given by Wallace, 1909 Results for $\text{Na}_2\text{SiO}_3 + \text{Na}_2\text{WO}_4$ are given by van Klooster, 1910-11.

SODIUM STANNATE $\text{Na}_2\text{Sn}(\text{OH})_6$.

SnO SOLUBILITY OF SODIUM STANNATE IN WATER. (Zocher, 1920.)

t°	Gms. $\text{Na}_2\text{Sn}(\text{OH})_6$ per 100 gms. sat. sol.	Solid Phase	t°	Gms. $\text{NaSn}(\text{OH})_6$ per 100 gms. sat. sol.	Solid Phase
- 5	31.8	$\text{Na}_2\text{Sn}(\text{OH})_6$	- 5	32.4	$\text{Na}_2\text{Sn}(\text{OH})_6 \cdot \text{H}_2\text{O}$
0	31.5	"	0	33.2	"
+21	30.4	"	+21	35.4	"
25	30.3	"	25	36.5	"
35	29.4	"	35	37.5	"
45	26.6	"	45	39.2	"
			50	41.1	"

SOLUBILITY OF SODIUM STANNATE IN WATER. (Reiff and Toussaint, 1939.)

t°	Gms. per 100 cc sat. sol.	Solid Phase	t°	Gms. per 100 cc sat. sol.	Solid Phase
$\text{Na}_2[\text{Sn}(\text{OH})_6]$	free NaOH		$\text{Na}[\text{Sn}(\text{OH})_6]$	free NaOH	
0	52.0	$\text{Na}_2\text{Sn}(\text{OH})_6$	60	37.0	$\text{Na}_2[\text{Sn}(\text{OH})_6] + \text{Sn}(\text{OH})_4$
20	46.0	"	80	33.0	" + "
25	43.5	"	100	30.0	" + "
40	41.5	"	120	27.0	" + "

SOLUBILITY OF SODIUM STANNATE IN AQUEOUS SOLUTIONS OF
SODIUM HYDROXIDE AND OF SODIUM CARBONATE.

(Reiff and Toussaint, 1939.)

The following approximate results were taken from the authors diagram

t°	Gms. $\text{Na}_2[\text{Sn}(\text{OH})_6]$ per 100 cc sat. solution in Aqueous ;				
	5 Percent NaOH	10 Percent NaOH	20 Percent NaOH	30 Percent NaOH	10 Percent Na_2CO_3
0	35	22.5	7	0.5	40
20	31	19	5.5	0.6	35.5
40	26	16	4.5	0.7	31
60	23	13.5	4.0	1.0	29
80	21	11.5	3.5	1.2	26.5
100	19.5	11.0	4.0	1.5	24.5
120	18.5	11.5	5.5	2.0	23.0

SOLUBILITY OF SODIUM STANNATE IN AQUEOUS 1.97 NORMAL SOLUTION
OF VARIOUS SODIUM SALTS AT 18°.

(Reiff and Toussaint, 1939.)

SnO

Aqueous 1.97 Normal Solution of:	Gms. $\text{Na}_2[\text{Sn}(\text{OH})_6]$ per 100 cc sat. sol.	Aqueous 1.97 Normal Solution of:	Gms. $\text{Na}_2[\text{Sn}(\text{OH})_6]$ per 100 cc sat. sol.
CH_3COONa	20.7	Na_2SO_3	35.0
NaOH	25.0	Na_2WO_4	35.0
NaF	28.8	NaNO_3	35.3
NaClO_4	30.1	NaBr	37.0
NaCl	31.5	Na_2CrO_4	37.5
NaI	33.0	Na_2SO_4	38.0
Na_2CO_3	34.8		

SODIUM TELLURIDE Na_2Te .

Fusion-point data for the system $\text{Na}_2\text{Te} + \text{Te}$ are given by Kraus and Glass, 1929.

SODIUM TELLURATE $\text{Na}_2\text{TeO}_4 \cdot 2\text{H}_2\text{O}$.

100 gms. H_2O dissolve 0.77 gm. Na_2TeO_4 at 18°, and 2 gms. at 100°. Solid phase $\text{Na}_2\text{TeO}_4 \cdot 2\text{H}_2\text{O}$.

100 gms. H_2O dissolve 1.43 gms. Na_2TeO_4 at 18°, and 2.5 gms. at 50°. Solid phase $\text{Na}_2\text{TeO}_4 \cdot 4\text{H}_2\text{O}$. (Mylus, 1901.)

VO

SODIUM MetaVANADATE NaVO_3 .

SOLUBILITY IN WATER.

(MacAdam and Pierle, 1912.)

t°	Gms. NaVO_3 per 100 Gms. H_2O .	Solid Phase.	t°	Gms. NaVO_3 per 100 Gms. H_2O .	Solid Phase.
25	21.10	NaVO_3	25	15.3	$\text{NaVO}_3 \cdot 2\text{H}_2\text{O}$
40	26.23	"	40	30.2	"
60	32.97	"	60	68.4	"
75	38.83	"	75	38.8	NaVO_3

Considerable time was required for attainment of equilibrium. The two solid phases appear to exist for the whole range of temperature and the conditions for the transformation of one into the other were not ascertained.

Na **NATRIUM**
SODIUM MetaVANADATE NaVO_3 .

1326

**EQUILIBRIUM IN THE SYSTEM SODIUM OXIDE, VANADIUM PENTOXIDE
AND WATER AT 30°.**

(Kiehl and Manfredo, 1937.)

d. of sat. sol.	Gm. Mols. per 100		Solid Phase	d. of sat. sol.	Gm. Mols. per 100		Solid Phase
	V_2O_5	Na_2O			V_2O_5	Na_2O	
0.996	0.010	—	$\text{V}_2\text{O}_5 \cdot x\text{H}_2\text{O}$	1.367	2.31	5.08	$\text{Na}_4\text{V}_2\text{O}_5 \cdot 18\text{H}_2\text{O}$
0.9955	0.004	0.002	$\text{V}_2\text{O}_5 \cdot x\text{H}_2\text{O} \cdot xy\text{H}_2\text{O}$	1.379	2.42	5.60	" + $\text{Na}_3\text{VO}_4 \cdot 12\text{H}_2\text{O}$
0.9979	0.03	0.026	" "	1.278	1.55	4.19	$\text{Na}_3\text{VO}_4 \cdot 12\text{H}_2\text{O}$
1.039	0.46	0.24	" "	1.228	1.12	3.54	" "
1.163	1.73	1.30	" "	1.172	0.67	2.97	" "
1.236	2.54	1.55	$\text{V}_2\text{O}_5 + \text{Na}_2\text{VO}_4 \cdot 12\text{H}_2\text{O}$	1.151	0.40	2.87	" "
1.219	2.34	1.58	$\text{Na}_4\text{V}_2\text{O}_5 \cdot 17\text{H}_2\text{O}$	1.151	0.22	3.19	" "
1.208	2.22	1.68	" + $\text{NaVO}_3 \cdot 2\text{H}_2\text{O}$	1.153	0.21	3.26	" "
1.187	1.95	1.53	$\text{NaVO}_3 \cdot 2\text{H}_2\text{O}$	1.165	0.14	3.66	" "
1.148	1.57	1.37	" "	1.183	0.11	4.04	" "
1.110	1.21	1.23	" "	1.208	0.08	4.76	" "
1.151	1.50	1.69	" "	1.312	0.06	7.55	" + $\text{Na}_3\text{VO}_4 \cdot 7\text{H}_2\text{O}$
1.265	2.36	3.19	" "	1.337	0.04	8.39	$\text{Na}_3\text{VO}_4 \cdot 7\text{H}_2\text{O}$
1.418	3.60	5.50	" "	1.411	0.03	10.94	" "
1.536	4.57	7.55	" + $\text{Na}_2\text{VO}_4 \cdot 18\text{H}_2\text{O}$	1.478	0.06	13.39	" "
1.460	3.76	6.47	$\text{Na}_2\text{VO}_4 \cdot 18\text{H}_2\text{O}$	1.472	0.08	13.99	" + $\text{Na}_3\text{VO}_4 \cdot 2\text{H}_2\text{O}$
1.363	2.56	4.93	" "	1.519	0.08	15.23	$\text{Na}_3\text{VO}_4 \cdot 2\text{H}_2\text{O}$
1.352	2.32	4.46	" "	1.557	0.08	16.96	" "
				1.549	0.00	16.81	" "

Fusion-point data for mixtures of $\text{Na}_2\text{O} + \text{V}_2\text{O}_5$ are given by Cannery, 1928.

SODIUM TUNGSTATE $\text{Na}_2\text{WO}_4 \cdot 2\text{H}_2\text{O}$.

SOLUBILITY IN WATER.

(Funk, 1900a.)

WO

t°.	Gms. Na_2WO_4 per 100 Gms. Solution.	Mols. Na_2WO_4 per 100 Mols. H_2O .	Solid Phase.	t°.	Gms. Na_2WO_4 per 100 Gms. Solution.	Mols. Na_2WO_4 per 100 Mols. H_2O .	Solid Phase.
-5	30.60	2.70	$\text{Na}_2\text{WO}_4 \cdot 10\text{H}_2\text{O}$	-3.5	41.67	4.37	$\text{Na}_2\text{WO}_4 \cdot 2\text{H}_2\text{O}$
-4	31.87	2.86	"	+0.5	41.73	4.39	"
-3.5	32.98	3.01	"	18	42.0	4.40	"
-2	34.52	3.23	"	21	42.27	4.48	"
0	36.54	3.52	"	43.5	43.98	4.81	"
+3	39.20	3.95	"	80.5	47.65	5.57	"
5	41.02	4.26	"	100	49.31	5.95	"

Sp. Gr. of sat. solution at 18° = 1.573. For Sp. Gr. determinations of aqueous solutions at 20°, see Pawlewski, 1900.

Fusion-point data for $\text{Na}_2\text{WO}_4 + \text{WO}_3$ are given by Parravano (1909); by Van Liempt, 1925; and by Hoermann, 1929.

SODIUM Para TUNGSTATE $5\text{Na}_2\text{O} \cdot 12\text{WO}_3 \cdot 28\text{H}_2\text{O}$.

SOLUBILITY OF SODIUM PARA TUNGSTATE IN WATER.

(Vallance, 1931; Rosenheim and Wolff, 1930.)

The original results in each case were plotted and the following figures taken from the curves. The solid phase was $5\text{Na}_2\text{O} \cdot 12\text{WO}_3 \cdot 28\text{H}_2\text{O}$ in each case.

t°	Gms. $5\text{Na}_2\text{O} \cdot 12\text{WO}_3$ per 100 gms. sat. sol.		t°	Gms. $5\text{Na}_2\text{O} \cdot 12\text{WO}_3$ per 100 gms. sat. sol.	
	(V)	(R & W)		(V)	(R & W)
0	2.1	2.10	50	26.5	21.0
10	4.2	4.2	60	35.0	28.0
20	7.5	7.5	70	43.0	35.0
25	9.0	9.0	80	52.0	—
30	11.4	10.7	90	61.0	—
40	18.0	15.0	100	70.0	—

WO

SODIUM ZINCATE $\text{Na}_2\text{O} \cdot \text{ZnO} \cdot 4\text{H}_2\text{O}$.

EQUILIBRIUM IN THE SYSTEM SODIUM OXIDE, ZINC OXIDE AND WATER AT 30°
(Goudriaan, 1919, 1920.)

Especially carefully purified materials were used. The solid phases were determined by the rest method of Schreinemakers. At the zinc hydroxide end of the curve crystallized $\text{Zn}(\text{OH})_2$ was used as solid phase and about two weeks allowed for the attainment of final equilibrium.

Gms. per 100 gms. sat. sol.		Solid Phase.	Gms. per 100 gms. sat. sol.		Solid Phase.
Na_2O .	ZnO .		Na_2O .	ZnO .	
11.8	2.6	ZnO	39.4	9.0	$\text{Na}_2\text{O} \cdot 0.3\text{H}_2\text{O}$
17.4	5.0	"	39.6	7.2	"
23.7	11.3	"	40.7	2.0	"
27.3	16.0	"	40.5	1.6	"
27.8	16.5	" + $\text{Na}_2\text{O} \cdot \text{ZnO} \cdot 4\text{H}_2\text{O}$	40.9	1.1	"
28.0	14.9	$\text{Na}_2\text{O} \cdot \text{ZnO} \cdot 4\text{H}_2\text{O}$	41.9	0.0	"
30.1	13.2	"	24.6	12.5	ZnO
31.8	11.7	"	19.9	15.2	$\text{Zn}(\text{OH})_2$
33.2	11.2	"	13.7	7.2	"
34.7	10.4	"	10.1	4.7	"
36.1	10.2	"	4.6	1.0	"
39.2	9.7	" + $\text{Na}_2\text{O} \cdot 0.3\text{H}_2\text{O}$	4.5	0.4	ZnO

ZnO

More recent determinations of the equilibrium in this system, differing more or less from the above, are given by Müller, Müller and Fauvel, 1927, and by Scholder and Hendrich, 1939. These latter investigators found that at 20° the solid phase at concentrations of NaOH between 1 and 13.4 normality, was ZnO . At concentrations between 13.5 and 19.6 normality it was $\text{Na}[\text{Zn}(\text{OH})_3]$ and at concentrations between 19.6 and 20.1 it was $\text{Na}_2[\text{Zn}(\text{OH})_4]$. Above 20.1 normality the solid phase consisted of mixtures of $\text{Na}_2[\text{Zn}(\text{OH})_4]$ and $\text{NaOH} \cdot \text{H}_2\text{O}$. At concentration of NaOH between 7.3 and 13.3 normality there are also present rhombic $\text{Zn}(\text{OH})_2$ and $\text{Na}_3[\text{Zn}(\text{OH})_3] \cdot 3\text{H}_2\text{O}$ as metastable solid phases. Less complete results at 30°, 40° and 100° are also given.

SODIUM FluozIRCONATE $5\text{NaF} \cdot \text{ZrF}_4$.

100 gms. H_2O dissolve 0.387 gm. at 18°, and 1.67 gms. at 100°. (Marignac, 1867.)

NEODYMIUM BROMATE $\text{Nd}(\text{BrO}_3)_3 \cdot 9\text{H}_2\text{O}$.SOLUBILITY OF NEODYMIUM BROMATE IN WATER
(Jarres, Fogg, McIntire, Evans and Donovan, 1927.)

	t°	Gms. $\text{Nd}(\text{BrO}_3)_3$ per 100 gms. sat. sol.	Solid Phase	t°	Gms. $\text{Nd}(\text{BrO}_3)_3$ per 100 gms. sat. sol.	Solid Phase
Br	0	30.52	$\text{Nd}(\text{BrO}_3)_3 \cdot 9\text{H}_2\text{O}$	25	46.06	$\text{Nd}(\text{BrO}_3)_3 \cdot 9\text{H}_2\text{O}$
	5	34.01	"	30	48.77	"
	10	37.19	"	35	51.48	"
	15	40.30	"	40	53.70	"
	20	43.04	"	45	56.90	"

NEODYMIUM ACETATE, $\text{Nd}(\text{CH}_3\text{COO})_3 \cdot \text{H}_2\text{O}$.

100 gms. sat. sol. of neodymium acetate in water contain 20.76 gms. $\text{Nd}(\text{CH}_3\text{COO})_3$ at 25°. Constant agitation was employed for obtaining saturation.

(Meyer and Müller, 1920.)

NEODYMIUM GLYCOLATE $\text{Nd}(\text{C}_2\text{H}_3\text{O}_3)_3$.

One liter H_2O dissolves 4.609 gms. salt at 20°.

(Jantsch & Grünkraut, 1912-13.)

CH

NEODYMIUM LACTATE, $\text{Nd}(\text{C}_3\text{H}_5\text{O}_3)_3 \cdot 2\frac{1}{2}\text{H}_2\text{O}$.

One liter of sat. solution of neodymium lactate in water contains 24.775 gms. $\text{Nd}(\text{C}_3\text{H}_5\text{O}_3)_3 \cdot 2\frac{1}{2}\text{H}_2\text{O}$ at 20°. Saturation was secured by constant agitation.

(Jantsch, 1926.)

NEODYMIUM SULFONATES.

SOLUBILITY IN WATER.

Sulfonate.	Formula.	t°.	Gms. Anhy- drous Salt per 100 Gms. H_2O .	Authority.
Neodymium:				
m { Nitrobenzene	$\text{Nd}[\text{C}_6\text{H}_4(\text{NO}_2)\text{SO}_3]_3 \cdot 6\text{H}_2\text{O}$	15	46.1	(Holmberg, 1907.)
Bromo { Sulfonate	$\text{Nd}[\text{C}_6\text{H}_3\text{Br}(\text{r})\text{NO}_2(4)\text{SO}_3(3)]_3 \cdot 8\text{H}_2\text{O}$	25	7.25	(Katz & James, 1913.)

NEODYMIUM COBALTICYANIDE $\text{Nd}_2(\text{CoC}_6\text{N}_6)_2 \cdot 9\text{H}_2\text{O}$.

1000 gms. aq. 10% HCl ($d_{15} = 1.05$) dissolve 4.19 gms. salt at 25°. (James & Willand, '16.)

NEODYMIUM Campho CARBONATE $\text{Nd}(\text{C}_{11}\text{H}_{15}\text{O}_3)_3$.CO SOLUBILITY OF NEODYMIUM CAMPHO CARBONATE IN SEVERAL SOLVENTS AT 15°.
(Picon, 1931.)

Solvent	Gms. $\text{Nd}(\text{C}_{11}\text{H}_{15}\text{O}_3)_3$ per 100 cc sat. sol.	Solvent	Gms. $\text{Nd}(\text{C}_{11}\text{H}_{15}\text{O}_3)_3$ per 100 cc sat. sol.
Water	0.7	Acetone	6.3
Methyl Alcohol	16.7	Benzene	50.+
Ethyl Alcohol	15.3	Chloroform	50.+
Ethyl Ether	4.9	CCl_4	50.+
Ethyl Acetate	5.9	Carbon DiSulfide	100
		Olive Oil	2.6

NEODYMIUM OXALATE $\text{Nd}_2(\text{C}_2\text{O}_4)_3 \cdot 10\text{H}_2\text{O}$.

SOLUBILITY IN WATER AT 25° BY ELECTROLYTIC DETERMINATION.
(Rimbach and Schubert, 1909.)

One liter sat. solution contains 0.0053 mg. equivalents of anhydrous salt = 0.49 milligram.

One liter sat. aqueous solution contains 0.00148 gm. $\text{Nd}_2(\text{C}_2\text{O}_4)_3$ at 25°, determined gravimetrically, and 0.00198 determined by electrolytic conductivity. (Sarver and Brinton, 1927.)

SOLUBILITY IN AQUEOUS 20% SOLUTIONS OF METHYL, ETHYL AND TRIETHYL AMINE OXALATES, ROUGHLY DETERMINED. (Grant and James, 1917.)

100 cc. aq. 20% methyl amine oxalate dissolve 0.027 gm. neodymium oxalate.
 " " ethyl " " " 0.107 " "
 " " triethyl " " " 0.065 " "

SOLUBILITY OF NEODYMIUM OXALATE IN AQUEOUS SOLUTIONS OF ACIDS AT 25°.

(Sarver and Brinton, 1927.)

Concentration of Aq. Solvent in Normality	Gms. $\text{Nd}_2(\text{C}_2\text{O}_4)_3$ per 100 gms. sat. sol.	Concentration of Aq. Solvent in Normality	Gms. $\text{Nd}_2(\text{C}_2\text{O}_4)_3$ per 100 gms. sat. sol.
0.1008 HCl	0.0076	0.2482 HNO_3	0.0238
0.2576 "	0.0217	1.992 "	0.4287
0.5004 "	0.0442	4.054 "	1.353
1.018 "	0.1260	2.000 " + 0.1 $(\text{COOH})_2$	0.1138
1.484 "	0.2222	3.03 " + 0.1 "	0.4606
2.000 "	0.3318	2.00 " + 0.5 "	0.0195
5.200 "	1.5330	3.03 " + 0.5 "	0.0811
0.978 " + 0.1 $(\text{COOH})_2$	0.0082	4.00 " + 0.5 "	0.2538
2.000 " + 0.1 "	0.0747	4.00 " + sat. "	0.0972
2.865 " + 0.1 "	0.2167	6.00 " + sat. "	0.3413
3.965 " + 0.1 "	0.5570	0.086 H_2SO_4	0.0091
0.978 " + 0.5 "	0.0020	0.419 "	0.0415
2.000 " + 0.5 "	0.0112	0.958 "	0.1037
2.865 " + 0.5 "	0.0352	1.846 "	0.2237
3.965 " + 0.5 "	0.1047	2.612 "	0.3702
1.484 " + sat. "	0.0033		
4.000 " + " "	0.0775	The determinations were made with very great care. The mixture was constantly rotated for several days.	
6.000 " + " "	0.1814		
6.200 " + " "	0.1785		

SOLUBILITY OF NEODYMIUM OXALATE IN AQUEOUS SOLUTIONS OF ACIDS AT 90°.

(Neckers and Kremers, 1928.)

The mixtures were shaken frequently during thirty-six hours.

Concentration of Aq. Solvent		Gms. Nd_2O_3 per 100 cc sat. sol.
Normality HNO_3	Percent $(\text{COOH})_2 \cdot 2\text{H}_2\text{O}$	
1.25	—	0.8707
2.50	—	1.9571
5.00	—	6.7788
1.25	5.0	0.0915
2.50	5.0	0.6760
5.00	5.0	5.1263

SOLUBILITY OF NEODYMIUM OXALATE IN AQUEOUS SOLUTIONS OF
NEODYMIUM NITRATE AT 25°. (James and Robinson, 1913.)

(The mixtures were constantly agitated at constant temperature for twelve weeks.)

Gms. per 100 Gms. Sat. Sol.		Solid Phase.	Gms. per 100 Gms. Sat. Sol.		Solid Phase.
$\text{Nd}_2(\text{C}_2\text{O}_4)_3$	$\text{Nd}_2(\text{NO}_3)_6$		$\text{Nd}_2(\text{C}_2\text{O}_4)_3$	$\text{Nd}_2(\text{NO}_3)_6$	
0.18	6.46	$\text{Nd}_2(\text{C}_2\text{O}_4)_3 \cdot 11\text{H}_2\text{O}$	2.07	47.64	$\text{Nd}_2(\text{C}_2\text{O}_4)_3 \cdot 11\text{H}_2\text{O}$
0.54	12.23	"	2.54	50.52	"
0.76	17.78	"	2.89	52.82	"
0.85	22.67	"	3.17	54.67	"
0.96	27.43	"	2.21	56.48 probably	$1.2\frac{1}{2}.24$
1.28	31.36	"	1.44	59.68	$\text{Nd}_2(\text{NO}_3)_6(? \text{H}_2\text{O})$
1.38	35.26	"	1.33	59.67	"
1.66	38.70	"	1.21	59.70	"
1.88	42.13	"	0.96	59.75	"
1.96	44.82	"	...	60.46	"

$$1.2\frac{1}{2}.24^* = \text{Nd}_2(\text{C}_2\text{O}_4)_3 \cdot 2\frac{1}{2}\text{Nd}_2(\text{NO}_3)_6 \cdot 24\text{H}_2\text{O}.$$

NEODYMIUM TRICHLORIDE, $\text{NdCl}_3 \cdot 6\text{H}_2\text{O}$.

SOLUBILITY OF NEODYMIUM TRICHLORIDE IN WATER AND IN HYDROCHLORIC ACID.
(Williams, Fogg and James, 1926)

Constant agitation was employed and equilibrium was approached from above and from below.

Cl

t°.	Gms. NdCl_3 per 100 gms. sat. sol. in Water.	Gms. NdCl_3 per 100 gms. sat. sol. in aq. HCl of $d = 1.1051$.	Solid Phase in each case.
10.....	49.16	26.16	$\text{NdCl}_3 \cdot 6\text{H}_2\text{O}$
20.....	49.49	26.57	"
30.....	49.91	27.92	"
40.....	50.41	29.83	"
55.....	51.11	31.94	"

SOLUBILITY OF NEODYMIUM TRICHLORIDE AND OF NEODYMIUM OXIDE IN AQUEOUS
SOLUTIONS OF AMMONIUM CHLORIDE AT 15°, 30°, 50° AND 100°.
(Prandtl and Rauchenberger, 1920.)

NOTE — The results are given only in the form of small scale diagrams and it is stated that the numerical data will be published in full in the dissertation of Johanna Rauchenberger, University of München, 1920. The equilibrium $\text{Nd}(\text{OH})_3 + 3\text{NH}_4\text{Cl} \rightleftharpoons \text{NdCl}_3 + 3\text{NH}_3 + 3\text{H}_2\text{O}$ was approached by the authors from both sides. The composition of the basic chlorides obtained by shaking the oxide with 1.0*n* NH_4Cl at different temperatures, and drying over soda lime, was approximately as follows :

At 15°. $\text{Nd}_4\text{Cl}_2\text{O}_5 \cdot 9\text{H}_2\text{O}$; At 30°. $\text{Nd}_8\text{Cl}_3\text{O}_{11} \cdot 11.20\text{H}_2\text{O} - \text{Nd}_{13}\text{Cl}_2\text{O}_{19} \cdot 11.30\text{H}_2\text{O}$; At 50°. $\text{Nd}_9\text{Cl}_3\text{O}_{12} \cdot 22\text{H}_2\text{O}$.

SOLUBILITY OF NEODYMIUM CHLORIDE IN WATER.

(Matignon, 1906, 1909.)

Method of obtaining saturation not stated.

t°.	d_{20} of Sat. Sol.	Gms. NdCl_3 per 100 Gms.		Gms. $\text{NdCl}_3 \cdot 6\text{H}_2\text{O}$ per 100 Gms.	
		Sat. Sol.	Water.	Sat. Sol.	Water.
13	1.74	49.67	98.68	71.12	246.2
100	...	...	140	...	...

100 gms. abs. alcohol dissolve 44.5 gms. (anhydrous) NdCl_3 at 20°. Saturation was obtained by spontaneous evaporation of the solution over H_2SO_4 .

100 gms. anhydrous pyridine dissolve 1.8 gms. anhydrous NdCl_3 at about 15°. Saturation obtained by daily agitation of the solution for some weeks. (Matignon, 1906.)

NEODYMIUM Hexa Antipyrine Per CHLORATE $[\text{Nd}(\text{COC}_{10}\text{H}_{12}\text{O}_2)_6](\text{ClO}_4)_3$

100 cc sat. solution of Neodymium Hexa antipyrine Per chlorate in water contain 0.08 gm. $[\text{Nd}(\text{COC}_{10}\text{H}_{12}\text{O}_2)_6](\text{ClO}_4)_3$ at 20°. (Wilke-Dörfurt and Schliephake, 1925.)

NEODYMIUM CHROMATE $\text{Nd}_2(\text{CrO}_4)_3 \cdot 8\text{H}_2\text{O}$.

100 gms. sat. solution of Neodymium Chromate in Water contain 0.027 gm. $\text{Nd}_2(\text{CrO}_4)_3$ at 25°. (Britton, 1924.)

NEODYMIUM MOLYBDATE $\text{Nd}_2(\text{MoO}_4)_3$.

One liter H_2O dissolves 0.0186 gm. salt at 28° and 0.0308 gm. at 75°. The mixtures were frequently stirred at constant temperature during only two hours. (Hitchcock, 1895.)

NEODYMIUM NITRATE $\text{Nd}(\text{NO}_3)_3 \cdot 6\text{H}_2\text{O}$. α and β
SOLUBILITY OF α AND β NEODYMIUM NITRATES IN WATER.
(Friend, 1935.)

t°	Gms. $\text{Nd}(\text{NO}_3)_3$ per 100 gms. sat. sol.	Solid Phase	t°	Gms. $\text{Nd}(\text{NO}_3)_3$ per 100 gms. sat. sol.	Solid Phase
0	55.97	$\text{Nd}(\text{NO}_3)_3 \cdot 6\text{H}_2\text{O} \alpha$	27.2	59.17	$\text{Nd}(\text{NO}_3)_3 \cdot 6\text{H}_2\text{O} \beta$
13.2	57.37	"	29.4	59.18	"
18.2	58.03	"	37.2	60.95	"
23.0	59.59	"	42.4	61.91	"
25. (1)	60.46	"	50.0	64.86	"
26.2	60.69	"	57.2	67.00	"
			66.2	73.13	"
			67.5 (m.pt.)	75.34	"

(1) James and Robinson, 1913.

NEODYMIUM NITRATE
SOLUBILITY OF NEODYMIUM NITRATE IN AQUEOUS SOLUTIONS OF NITRIC ACID.
(Quill and Robey, 1937.)

Results at 25°

d. of sat. sol.	Gms. per 100 HNO_3	Gms. sat. sol. $\text{Nd}(\text{NO}_3)_2$	Solid Phase
—	0.0	59.0	Nd.6
1.741	6.20	53.31	"
—	6.36	52.15	"
—	18.28	40.79	"
—	43.95	23.64	"
—	44.63	24.08	"
1.595	49.20	23.47	Nd.4
1.572	56.65	19.11	"

Results at 50°

d. of sat. sol.	Gms. per 100 HNO_3	Gms. sat. sol. $\text{Nd}(\text{NO}_3)_2$	Solid Phase
1.963	0.0	66.26	Nd.6
1.948	2.14	64.62	"
1.901	6.92	60.34	"
1.885	10.41	57.74	"
1.997	11.93	59.47	" + Nd4
—	22.67	51.24	Nd.4
1.819	26.83	47.36	"
—	46.55	32.49	"
—	45.46	34.97	"

Nd.6 = $\text{Nd}(\text{NO}_3)_3 \cdot 6\text{H}_2\text{O}$; Nd.4 = $\text{Nd}(\text{NO}_3)_3 \cdot 4\text{H}_2\text{O}$.

100 cc of a sat. solution of $\text{Nd}(\text{NO}_3)_3$ in Ethyl Ether, prepared by frequent agitation and allowing to stand over night at about 20°, contain 0.20 gm. Nd_2O_3 . A saturated ethereal solution prepared as above but using neodymium nitrate which had been dehydrated at 150°, contain 2.67 gm. Nd_2O_3 per 100 cc of solution. (Wells, 1930.)

Nd NEODYMIUM

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NEODYMIUM Cobalt NITRATE, $2 \text{Nd}(\text{NO}_3)_3 \cdot 3 \text{Co}(\text{NO}_3)_2 \cdot 24 \text{H}_2\text{O}$.SOLUBILITY OF NEODYMIUM COBALT NITRATE IN WATER
(Prandtl and Ducru, 1926.)

t°.	d. of. sat. sol.	Gms. per 1000 gms. sat. sol.		
		Nd_2O_3 .	CoO .	Double salt,
15....	1.65	14.0	9.28	68.3
30....	1.68	14.84	9.84	72.4
45....	1.72	15.71	10.43	76.6
60....	1.77	16.63	11.16	81.1

SOLUBILITY OF NEODYMIUM DOUBLE NITRATES IN WATER. (Prandtl and Ducru, 1926.)

The saturated solutions were prepared by constant shaking in a thermostat.

Double salt of	t°.	d of sat. sol.	Gms. per 100 gms. sat. sol.		
			Nd_2O_3 .	Other metal oxide.	Double salt.
Neodymium magnesium nitrate $2\text{Nd}(\text{NO}_3)_3 \cdot 3\text{Mg}(\text{NO}_3)_2 \cdot 24 \text{H}_2\text{O}$	15	1.52	14.45	5.17 (MgO)	66.0
	30	1.55	15.20	5.49 "	69.5
	50	1.59	16.34	5.78 "	74.4
	70	1.64	17.47	6.29 "	79.8
Neodymium manganese nitrate $2\text{Nd}(\text{NO}_3)_3 \cdot 3\text{Mn}(\text{NO}_3)_2 \cdot 24 \text{H}_2\text{O}$	15	1.66	15.24	9.50 (MnO)	73.8
	30	1.70	15.99	10.15 "	77.4
	45	1.75	17.05	10.68 "	82.6
	60	1.82	18.37	11.48 "	89.0
Neodymium nickel nitrate $2\text{Nd}(\text{NO}_3)_3 \cdot 3\text{Ni}(\text{NO}_3)_2 \cdot 24 \text{H}_2\text{O}$	15	1.63	14.01	9.13 (NiO)	68.4
	30	1.66	14.66	9.73 "	71.5
	45	1.69	15.41	10.12 "	75.1
	60	1.74	16.36	10.89 "	79.8
Neodymium zinc nitrate $2\text{Nd}(\text{NO}_3)_3 \cdot 3\text{Zn}(\text{NO}_3)_2 \cdot 24 \text{H}_2\text{O}$	15	1.65	14.00	10.15 (ZnO)	69.1
	30	1.69	14.88	10.79 "	73.5
	50	1.75	15.86	11.53 "	78.3
	70	1.81	17.15	12.33 "	84.6

NEODYMIUM Double NITRATES.

SOLUBILITY IN Aq. HNO_3 OF $d_{15} = 1.325 (= 51.59 \text{ GMS. HNO}_3 \text{ PER } 100 \text{ CC.})$ AT 16° . (Jantsch, 1912.)

Double Salt.	Formula.	Gms. Hydrated Double Salt per 100 Gms. Sat. Sol.
Neodymium Magnesium Nitrate	$[\text{Nd}(\text{NO}_3)_6]_2\text{Mg}_3 \cdot 24\text{H}_2\text{O}$	97.7
" Nickel	" Ni_3 "	116.6
" Cobalt	" Co_3 "	151.6
" Zinc	" Zn_3 "	177
" Manganese	" Mn_3 "	296

NEODYMIUM OXIDE Nd_2O_3 .O One liter sat. solution of Neodymium Oxide in Water contain 0.00000575 gm. mol. Nd_2O_3 at 29° . (Bush, 1927.)NEODYMIUM Dimethyl PHOSPHATE $\text{Nd}_2[(\text{CH}_3)_2\text{PO}_4]_6$.100 gms. H_2O dissolve 56.1 gms. $\text{Nd}_2[(\text{CH}_3)_2\text{PO}_4]_6$ at 25° and about 22.3 gms. at 95° . (Morgan and James, 1914.)

NEODYMIUM SULFATE $\text{Nd}_2(\text{SO}_4)_3 \cdot 8\text{H}_2\text{O} \alpha$.

SOLUBILITY OF NEODYMIUM SULFATE IN WATER.

The results of Friend, 1930; Meyer, R. J. (private communication to Landoldt & Bornstein Tabellen) and Jackson and Reinacker, 1930, were plotted and the following values taken from the average curve.

t°	Gms. $\text{Nd}_2(\text{SO}_4)_3$ per 100 gms. sat. sol.	Solid Phase	t°	Gms. $\text{Nd}_2(\text{SO}_4)_3$ per 100 gms. sat. sol.	Solid Phase
0	11.5	$\text{Nd}_2(\text{SO}_4)_3 \cdot 15\text{H}_2\text{O}$	50	3.2	$\text{Nd}_2(\text{SO}_4)_3 \cdot 8\text{H}_2\text{O} \alpha$
10	8.8	$\text{Nd}_2(\text{SO}_4)_3 \cdot 8\text{H}_2\text{O} \alpha$	60	2.7	"
20	6.6	"	70	2.4	"
25	5.8	"	85	2.0	"
30	5.0	"	87	1.2	$\text{Nd}_2(\text{SO}_4)_3 \cdot 8\text{H}_2\text{O} \beta$
40	3.9	"	95	1.15	"
			100	1.2	"

The previous results of Muthmann and Rohg, 1898, are not in good agreement with the later determinations.

SOLUBILITY OF NEODYMIUM SULFATE IN AQUEOUS SOLUTIONS
OF SULFURIC ACID.

(Friend, 1930.)

SO

Results for Aqueous:

0.33 normal H_2SO_4		1.0 normal H_2SO_4		4.0 normal H_2SO_4		8.0 normal H_2SO_4	
t°	Gms. $\text{Nd}_2(\text{SO}_4)_3$ per 100 gms. sat. sol.	t°	Gms. $\text{Nd}_2(\text{SO}_4)_3$ per 100 gms. sat. sol.	t°	Gms. $\text{Nd}_2(\text{SO}_4)_3$ per 100 gms. sat. sol.	t°	Gms. $\text{Nd}_2(\text{SO}_4)_3$ per 100 gms. sat. sol.
0	10.04	0.2	9.89	0.2	4.56	11.0	1.62
30.4	5.71	15.4	7.0	14.8	3.92	30.4	2.04
46.4	4.79	30.4	6.10	30.4	3.61	46.4	2.19
81.0	3.54	79.2	4.41	46.4	3.78		
89.6	2.15	90.0	3.41	59.0	3.62		
		96.8	2.69				

NEODYMIUM Potassium SULFATES.

EQUILIBRIUM IN THE SYSTEM NEODYMIUM SULFATE, POTASSIUM SULFATE
AND WATER AT 25° . (Zambonini and V. Cagliotti, 1924.)

Gms. per 100 gms. sat. sol.		Solid Phase.	Gms. per 100 gms. sat. sol.		Solid Phase.
$\text{Nd}_2(\text{SO}_4)_3$	K_2SO_4		$\text{Nd}_2(\text{SO}_4)_3$	K_2SO_4	
2.76	0.00	1.1.2	0.18	3.01	1.3.2
2.02	0.15	"	0.17	3.40	" + 1.4.1
1.69	0.30	"	0.08	4.06	1.4.1
1.62	0.47	" + 2.3.8	0.08	4.94	"
1.13	0.54	2.3.8	0.07	6.20	1.4.2
0.26	1.75	"	0.04	8.52	"
0.17	2.61	"	0.04	10.01	"
0.17	2.80	" + 1.3.2	0.04	10.85	1.5.2
0.18	2.98	"	0.00	11.18	" + K_2SO_4
1.1.2 = $\text{Nd}_2(\text{SO}_4)_3 \cdot \text{K}_2\text{SO}_4 \cdot 2\text{H}_2\text{O}$; 2.3.8 = $2\text{Nd}_2(\text{SO}_4)_3 \cdot 3\text{K}_2\text{SO}_4 \cdot 8\text{H}_2\text{O}$; 1.3.2 = $\text{Nd}_2(\text{SO}_4)_3 \cdot 3\text{K}_2\text{SO}_4 \cdot 2\text{H}_2\text{O}$; 1.4.1 = $\text{Nd}_2(\text{SO}_4)_3 \cdot 4\text{K}_2\text{SO}_4 \cdot \text{H}_2\text{O}$; 1.4.2 = $\text{Nd}_2(\text{SO}_4)_3 \cdot 4\text{K}_2\text{SO}_4 \cdot 2\text{H}_2\text{O}$; 1.5.2 = $\text{Nd}_2(\text{SO}_4)_3 \cdot 5\text{K}_2\text{SO}_4 \cdot 2\text{H}_2\text{O}$.					

NEODYMIUM Sodium SULFATES.

EQUILIBRIUM IN THE SYSTEM NEODYMIUM SULFATE, SODIUM SULFATE
AND WATER AT 23°. (Zambonini and Carobbi, 1925 a.)

Gms. per 100 gms. sat. sol.		Solid Phase.	Gms. per 100 gms. sat. sol.		Solid Phase.
$\text{Nd}_2(\text{SO}_4)_3$	Na_2SO_4		$\text{Nd}_2(\text{SO}_4)_3$	Na_2SO_4	
2.37	0.57	$\text{Nd}_2(\text{SO}_4)_3 \cdot 8\text{H}_2\text{O}$	—	9.11	4.5.8
1.11	0.14	» + 1.1.2	—	8.97	» + 3.4.6
0.28	0.49	1.1.2	—	10.98	3.4.6
0.14	1.24	»	—	13.16	»
—	3.11	»	—	14.54	» + 2.3.5
—	5.02	»	—	16.92	2.3.5
—	6.00	4.5.8	—	17.61	»
—	7.72	»	—	17.95	» + Na_2SO_4

1.1.2 = $\text{Nd}_2(\text{SO}_4)_3 \cdot \text{Na}_2\text{SO}_4 \cdot 2\text{H}_2\text{O}$; 4.5.8 = $4\text{Nd}_2(\text{SO}_4)_3 \cdot 5\text{Na}_2\text{SO}_4 \cdot 8\text{H}_2\text{O}$; 3.4.6 = $3\text{Nd}_2(\text{SO}_4)_3 \cdot 4\text{Na}_2\text{SO}_4 \cdot 6\text{H}_2\text{O}$
2.3.5 = $2\text{Nd}_2(\text{SO}_4)_3 \cdot 3\text{Na}_2\text{SO}_4 \cdot 5\text{H}_2\text{O}$.

NEODYMIUM Ammonium SULFATE $\text{Nd}_2(\text{SO}_4)_3 \cdot (\text{NH}_4)_2\text{SO}_4 \cdot 8\text{H}_2\text{O}$.

EQUILIBRIUM IN THE SYSTEM NEODYMIUM SULFATE, AMMONIUM SULFATE
AND WATER AT 25°.

(Zambonini, and Stolfi, 1927.)

SO

Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase
$\text{Nd}_2(\text{SO}_4)_3$	$(\text{NH}_4)_2\text{SO}_4$		$\text{Nd}_2(\text{SO}_4)_3$	$(\text{NH}_4)_2\text{SO}_4$	
4.50	0.77	$\text{Nd}_2(\text{SO}_4)_3 \cdot 8\text{H}_2\text{O}$ + 1.1.8	0.58	26.98	1.1.8
3.17	0.77	"	0.58	29.18	"
2.58	1.00	1.1.8	0.58	35.18	"
1.16	2.78	"	0.58	37.55	"
0.58	12.86	"	0.58	40.88	"
0.58	16.21	"	0.58	43.90	" + $(\text{NH}_4)_2\text{SO}_4$
0.58	24.25	"			

$$1.1.8 = \text{Nd}_2(\text{SO}_4)_3 \cdot (\text{NH}_4)_2\text{SO}_4 \cdot 8\text{H}_2\text{O}.$$

NEODYMIUM Rubidium SULFATE $\text{Nd}_2(\text{SO}_4)_3 \cdot \text{Rb}_2\text{SO}_4 \cdot 8\text{H}_2\text{O}$.

100 gms. H_2O sat. with $\text{NdRb}(\text{SeO}_4)_2 \cdot 4\text{H}_2\text{O}$ contain 12.5 gms. of the compound at 0° and 13.6 gms. at 26°. (Meyer and Kittlemann, 1931.)

EQUILIBRIUM IN THE SYSTEM NEODYMIUM SULFATE, RUBIDIUM
SULFATE AND WATER AT 25°.

(Zambonini and Cagliotti, 1927.)

Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase
$\text{Nd}_2(\text{SO}_4)_3$	Rb_2SO_4		$\text{Nd}_2(\text{SO}_4)_3$	Rb_2SO_4	
4.90	1.05	$\text{Nd}_2(\text{SO}_4)_3 \cdot 8\text{H}_2\text{O}$ + 1.1.8	—	5.16	1.1.8
4.73	1.20	1.1.8	—	7.93	"
2.29	1.43	"	—	24.92	"
0.74	1.80	"	—	33.63	"
0.21	2.99	"	—	45.54	" + Rb_2SO_4

$$1.1.8 = \text{Nd}_2(\text{SO}_4)_3 \cdot \text{Rb}_2\text{SO}_4 \cdot 8\text{H}_2\text{O}.$$

EQUILIBRIUM IN THE SYSTEM NEODYMIUM SULFATE, THALLIUM SULFATE
AND WATER AT 23°. (Zambonini and Cagliotti, 1925.)

Gms. per 100 gms. sat. sol.		Solid Phase.	Gms. per 100 gms. sat. sol.		Solid Phase.
$\text{Nd}_2(\text{SO}_4)_3$	Tl_2SO_4		$\text{Nd}_2(\text{SO}_4)_3$	Tl_2SO_4	
4.89	0.25	$\text{Nd}_2(\text{SO}_4)_3 \cdot 8\text{H}_2\text{O} + 1.1.3$	0.30	3.00	1.1.8
4.50	0.25	"	0.27	3.51	" + 1.4 ¹ / ₂
3.84	0.26	1.1.3	0.26	3.81	"
3.81	0.27	"	0.26	3.85	1.4 ¹ / ₂
3.80	0.27	"	0.24	4.10	"
3.78	0.28	1.1.8	0.19	4.70	"
3.15	0.30	"	0.16	4.85	" + Tl_2SO_4
1.86	0.45	"	0.11	4.90	" "
0.76	1.11	"	0.09	5.02	" "

1.1.3 = $\text{Nd}_2(\text{SO}_4)_3 \cdot \text{Tl}_2\text{SO}_4 \cdot 3\text{H}_2\text{O}$; 1.1.8 = $\text{Nd}_2(\text{SO}_4)_3 \cdot \text{Tl}_2\text{SO}_4 \cdot 8\text{H}_2\text{O}$;

1.4¹/₂ = $\text{Nd}_2(\text{SO}_4)_3 \cdot 4\frac{1}{2}\text{Tl}_2\text{SO}_4$.

NEODYMIUM SELENATE $\text{Nd}_2(\text{SeO}_4)_3 \cdot \text{Aq.}$

SOLUBILITY OF NEODYMIUM SELENATE IN WATER.

(Friend, 1921.)

The authors results were plotted and the following values taken from the average curve.

Se

t°	Gms. $\text{Nd}_2(\text{SeO}_4)_3$ per 100 gms. sat. sol.	Solid Phase	t°	Gms. $\text{Nd}_2(\text{SeO}_4)_3$ per 100 gms. sat. sol.	Solid Phase
0	31.0	$\text{Nd}(\text{SeO}_4)_3 \cdot \text{Aq.}$	50	29.2	$\text{Nd}_2(\text{SeO}_4)_3 \cdot \text{Aq.}$
10.6	30.9	"	60	30.5	" + $\text{Nd}_2(\text{SeO}_4)_3 \cdot 6\text{H}_2\text{O}$
20.0	29.5	"	62.5	22.0	$\text{Nd}_2(\text{SeO}_4)_3 \cdot 6\text{H}_2\text{O}$
25.0	29.0	"	65	16.0	"
30	28.5	"	70	12.0	"
40	28.5	"	80	6.5	"
			90	3.2	"

The following results, differing very greatly from the above, are given by Meyer and Kittlemann, 1931.

t°	Gms. $\text{Nd}_2(\text{SeO}_4)_3$ per 100 gms. H_2O in contact with:	
	$\text{Nd}_2(\text{SeO}_4)_3 \cdot 8\text{H}_2\text{O}$	$\text{Nd}_2(\text{SeO}_4)_3 \cdot 6\text{H}_2\text{O}$
0	4	30
20	12	40

SOLUBILITY OF NEODYMIUM SELENATE IN AQUEOUS SOLUTIONS OF SELENIC ACID.

(Friend, 1931.)

t°	Gms. per 100 gms. sat. sol.		t°	Gms. per 100 gms. sat. sol.	
	H_2SeO_4	$\text{Nd}_2(\text{SeO}_4)_3$		H_2SeO_4	$\text{Nd}_2(\text{SeO}_4)_3$
0	3.84	29.54	40	60.0	7.9
8.6	5.87	26.29	45.6	1.34	28.27
13.0	5.93	24.92	45.6	5.49	27.35
17.6	8.6	25.23	45.6	6.39	27.18
17.0	12.4	23.72	55.4	1.66	27.29
24.0	4.14	26.35	84.4	44.0	7.55
30.0	4.52	25.32			

NEODYMIUM TUNGSTATE $\text{Nd}_2(\text{WO}_4)_3$.

One liter H_2O dissolves 0.0190 gm. $\text{Nd}_2(\text{WO}_4)_3$ at 22° , 0.0168 gm. at 65° and 0.0152 gm. at 98° . The mixtures were not constantly agitated and only two hours were allowed for saturation.

(Hitchcock, 1895.)

NEON Ne.**SOLUBILITY OF NEON IN WATER.** (von Antropoff, 1919.)

The following new determinations were made in a refined apparatus arranged so that the solvent and its vapor touched no cock, and in which other improvements were introduced. The results are given in terms of the Bunsen coefficient as modified by Kuenen, that is, in terms of the volume of gas in cc. (reduced to normal conditions) dissolved by 1 gram of H_2O .

t°.	Absorb. coef. β .	t°.	Absorb. coef. β .	t°.	Absorb. coef. β .
0.....	0.0114	20.....	0.0147	40.....	0.0217
10.....	0.0108	30.....	0.0155	50.....	0.0322

Determinations which are not in agreement with the above are given by Valentin, 1922. This author questioned the report that neon differed from the other noble gases in showing an increase of solubility with temperature. Three series of determinations made by him agreed in showing on the contrary that the solubility of neon decreases with temperature. The results were as follows :

t°.	Cc. Neon dissolved per 1.0 gm. H_2O .	t°.	Cc. Neon dissolved per 1.0 gm. H_2O .	t°.	Cc. Neon dissolved per 1.0 gm. H_2O .
0.....	0.026	17.....	0.018	45.....	0.011

Tables showing the density and volume of neon at temperatures between 20° and $-217^\circ.52$ and at pressures varying from about 22 to 90 atmospheres are given by Crommelin, Martinez and Kamerlingh-Onnes, 1919, 1920.

SOLUBILITY OF NEON IN WATER AND IN OTHER SOLVENTS.

(Lannung, 1930.)

The results are expressed both in terms of a , the Bunsen Coefficient of solubility, and l the Ostwald solubility expression (See page 553)

Solvent	Solubility of Neon at:					
	15°	18°	20°	25°	30°	37°
Water	$\{ a$ 0.0108	0.0105	0.0104	0.0101	0.0099	0.0096
	$\{ l$ 0.0114	0.0112	0.0112	0.0110	0.0110	0.0111
Methyl Alcohol	$\{ a$ 0.0413	0.0423	0.0430	0.0444	0.0459	0.0480
	$\{ l$ 0.0436	0.0451	0.0462	0.0485	0.0509	0.0545
Ethyl Alcohol	$\{ a$ 0.0381	0.0394	0.0402	0.0417	0.0433	0.0442
	$\{ l$ 0.0402	0.0420	0.0431	0.0455	0.0481	0.0502
Acetone	$\{ a$ 0.043	0.045	0.046	0.048	—	—
	$\{ l$ 0.045	0.048	0.049	0.052	—	—
Benzene	$\{ a$ 0.0254	0.0264	0.0271	0.0288	0.0306	0.0330
	$\{ l$ 0.0268	0.0287	0.0291	0.0314	0.0340	0.0375
Cyclohexane	$\{ a$ 0.0333	0.0345	0.0353	0.0373	0.0392	0.0419
	$\{ l$ 0.0351	0.0368	0.0379	0.0407	0.0435	0.0476
Cyclohexanol	$\{ a$ —	—	—	0.0152	0.0161	0.0173
	$\{ l$ —	—	—	0.0166	0.0179	0.0196

One liter of Cyclohexanol ($\text{C}_6\text{H}_{11}\text{OH}$) dissolve 171.2 cc Ne_2 at 26° and 755 mm pressure. (Cauquil, 1927.)

NICKEL Ni

Qualitative data showing that just as iron, nickel is considerably attacked by water containing carbon dioxide, with formation of nickel carbonate, are given by Robl, 1924. A few quantitative results for special conditions are given.

Data for the distribution of nickel between zinc and lead are given by Tammann and Schaftmeister, 1924.

SOLUBILITY OF NICKEL IN MILK.

(Quam, 1929.)

Highly polished 4×7.5 cm. strips of nickel were each immersed in 50 cc portions of raw milk and rocked 46 times per minute for one-half hour. The loss in weight of the Ni strips was determined and expressed as milligrams Ni dissolved per sq. decimeter of surface exposed. The dissolved nickel was also determined in the ash of the 50 cc of milk by a modification of the α benzil dioxane method.

t°	Mgs. Ni dissolved per sq. decimeter of metal	t°	Mgs. Ni dissolved per sq. decimeter of metal
20	0.86	75	6.54
30	1.22	80	6.54
45	3.442	85	5.17
55	4.31	90	3.442
62.8	5.85	95	1.22

SOLUBILITY OF NICKEL IN MERCURY.

(Irvin and Russell, 1932.)

An amalgam prepared from 0.2 gm. Ni in about 200 gms. Hg by electrolysis was filtered after two days through its own paste on a ground glass filter and the dissolved nickel in this filtrate found to be less than 0.00002 gm. per 100 gms. Hg. A determination by Tammann, Kollmann and Hinnuber, 1927, by potential difference measurements gave the result 0.0057 gm. mol. Ni per 1.0 gm. mol. Hg at 15°.

NICKEL BROMIDE $\text{NiBr}_2 \cdot 6\text{H}_2\text{O}$.

Br

SOLUBILITY IN WATER.

(Etard, 1894.)

t°	Gms. NiBr_2 per 100 Gms. Solution.	t°	Gms. NiBr_2 per 100 Gms. Solution.	t°	Gms. NiBr_2 per 100 Gms. Solution.
-20	47.7	25	57.3	80	60.6
-10	50.5	30	58	100	60.8
0	53	40	59.1	120	60.9
+10	55	50	60	140	61
20	56.7	60	60.4		

SOLUBILITY OF NICKEL BROMIDE IN PURE METHYL ALCOHOL.
(Lloyd, Brown, Glynwyn, Bonnel and Jones, 1928.)

t°	Gms. NiBr ₂ per 100 gms. CH ₃ OH	Solid Phase	t°	Gms. NiBr ₂ per 100 gms. CH ₃ OH	Solid Phase
10	33.0	NiBr ₂ ·6CH ₃ OH	50	49.1	NiBr ₂
20	35.1	"	60	53.7	"
30	38.1	"	70	59.6	"
40	43.3	"			

SOLUBILITY OF NICKEL BROMIDE IN ABSOLUTE ACETONE.
(Bell, Rowlands, Bamford, Thomas and Jones, 1930.)

Br	t°	Gms. NiBr ₂ per 100 gms. CH ₃ COCH ₃	Solid Phase	t°	Gms. NiBr ₂ per 100 gms. CH ₃ COCH ₃	Solid Phase
	0	1.66	NiBr ₂	30	0.55	NiBr ₂
	10	1.16	"	40	0.36	"
	20	0.81	"	50	0.27	"

NICKEL BROMATE Ni(BrO₃)₂·6H₂O.

100 gms. cold water dissolve 27.6 gms. nickel bromate.

NICKEL ACETATE Ni(CH₃COO)₂

The mean of four determinations of the Solubility of Nickel Acetate in pure acetic acid, by Davidson and Chappell, 1933, was 12.37 mol. percent Ni(CH₃COO)₂ at 30°. The solid phase consisted of a finely divided greenish white substance without crystalline structure and containing from 54 to 66 mol. percent Ni(CH₃COO)₂, thus indicating a solvated product of variable composition. Freezing-point determinations of Ni(CH₃COO)₂ + CH₃COOH mixtures are also given.

CH **NICKEL** β MethylADIPATE.

100 cc. of sat. solution of neutral nickel racemic β methyladipate in water, contain 7.3 gms of the salt at 20°. (Meurissc.)

NICKEL CITRATE Ni₃[(COOCH₂)₂C(OH)COO]₂·2H₂O.

100 cc. sat. solution in water contain 0.28 gm. Ni = 0.94 gm. anhydrous salt at 10°. (Pickering, 1915.)

NICKEL Potassium CITRATE K₄Ni[(COOCH₂)₂COHCOO]₂.

100 cc. sat. sol. in water contain 3.9 gms. Ni = 41 gms. salt at 10°. (Pickering, 1915.)

NICKEL MALATE Ni[CH₂CHOH(COO)]₂·3H₂O.

100 cc. sat. solution in water contain 0.02 gm. Ni = 0.06 gm. salt at 10°. (Pickering, 1915.)

NICKEL FUMARATE Ni·C₄H₂O₄·5H₂O.

100 gms. H₂O dissolve 0.36 gm. Ni C₄H₂O₄ at 30°. (Weiss and Downs, 1923.)

NICKEL GLUCONATE $\text{Ni}(\text{C}_6\text{H}_{11}\text{O}_7)_2 \cdot 3\text{H}_2\text{O}$.

100 cc sat. solution of Nickel Gluconate in Water contain 9.65 gms. $\text{Ni}(\text{C}_6\text{H}_{11}\text{O}_7)_2$ at 25°. (May, Weisberg and Herrick, 1929.)

NICKEL BENZOATE $\text{Ni}(\text{C}_6\text{H}_5\text{COO})_2 \cdot 3\text{H}_2\text{O}$.**NICKEL Chlor, Oxy and Nitro BENZOATES.**

SOLUBILITY OF EACH SEPARATELY IN WATER AT 20°.

(Ephraim and Pfister, 1925.)

Compound.	Formula.	Gms. anhydrous empd. per 100 cc. sat. sol.
Nickel Benzoate.....	$\text{Ni}(\text{C}_6\text{H}_5\text{COO})_2 \cdot 3\text{H}_2\text{O}$	1.291
» -4-Chlor Benzoate...	$\text{Ni}(\text{C}_6\text{H}_4\text{ClCOO})_2 \cdot 4\text{H}_2\text{O}$	0.660
» -4-Oxy » ...	$\text{Ni}(\text{C}_6\text{H}_4\text{OHCOO})_2 \cdot 7\text{H}_2\text{O}$	0.871
» -4-Nitro » ...	$\text{Ni}(\text{C}_6\text{H}_4\text{NO}_2\text{COO})_2 \cdot 8\text{H}_2\text{O}$	0.777

100 gms. Methyl Alcohol (CH_3OH) dissolve 0.29 gm. $\text{Ni}(\text{C}_6\text{H}_5\text{COO})_2$ at 15° and 0.30 gm. at 66° (b.pt.). (Henstock, 1934.)

NICKEL Nitroso β Phenyl HYDROXYLAMINE $\text{Ni}[\text{C}_6\text{H}_5\text{N}(\text{NO})\text{O}]_2$.

The compound is prepared by precipitating Cupferron (the ammonium salt of nitroso phenyl hydroxylamine) with a nickel salt.

One liter sat. solution of the compound in water contains 0.00089 gm. at. (= 0.052 gm.) $\text{Ni}[\text{C}_6\text{H}_5\text{N}(\text{NO})\text{O}]_2$ at 18°. (Pinkus and Martin, 1927.)

NICKEL CINNAMATE $\text{Ni} \cdot \text{C}_{18}\text{H}_{14}\text{O}_4 \cdot 2\text{H}_2\text{O}$.

100 cc. sat. sol. of nickel cinnamate in water contain 0.293 gm. $\text{Ni} \cdot \text{C}_{18}\text{H}_{14}\text{O}_4$ at 20°. (Ephraim and Pfister, 1925.)

NICKEL HELIANTHATE $\text{Ni}(\text{C}_{14}\text{H}_{14}\text{N}_3\text{SO}_3)_2 \cdot 4\text{H}_2\text{O}$.

1000 cc. H_2O dissolve 0.072 gms. of the salt at 20-25°. (Stark and Dehn, 1918.)

NICKEL Anthracene, Benzene and Naphthalene SULFONATES.

SOLUBILITY OF EACH SEPARATELY IN WATER.

(Ephraim and Pfister, 1925, 1925a; Ephraim and Seger, 1925.)

Compound.	Formula.	t°.	Gms. anhydrous empd. per 100 cc. sat. sol.
Nickel Anthracene-1-sulfonate.....	$\text{Ni}(\text{C}_{14}\text{H}_9\text{SO}_3)_2 \cdot 6\text{H}_2\text{O}$	20	0.0253
» » -2- »	$\text{Ni}(\text{C}_{14}\text{H}_9\text{SO}_3)_2 \cdot 6\text{H}_2\text{O}$	20	0.00463
» Benzene sulfonate.....	$\text{Ni}(\text{C}_6\text{H}_5\text{SO}_3)_2 \cdot 6\text{H}_2\text{O}$	18	12.561
» » »	»	34	16.518
» » »	»	49.5	20.972
» » »	»	64.5	26.685
» » »	»	80.5	33.295
» » »	»	82.0	34.044
» Naphthalene-1-sulfonate.....	$\text{Ni}(\text{C}_{10}\text{H}_7\text{SO}_3)_2 \cdot 6\text{H}_2\text{O}$	17	4.978
» » -2 »	$\text{Ni}(\text{C}_{10}\text{H}_7\text{SO}_3)_2 \cdot 6\text{H}_2\text{O}$	16.5	0.2833
» » »	»	34.5	0.5289
» » »	»	45.5	0.7434
» » »	»	58.5	1.1658
» » »	»	70.5	1.5972
» » »	»	77.0	1.9973
» » »	»	81.5	2.4136
» » »	»	83.0	2.6886
» » -5-Chlor -1-sulfonate...	$\text{Ni}(\text{C}_{10}\text{H}_6\text{SO}_2\text{Cl})_2 \cdot 4\text{H}_2\text{O}$	20.0	0.618
» » -6-Oxy -2- » ...	$\text{Ni}(\text{C}_{10}\text{H}_6\text{SO}_3)_2 \cdot 8\text{H}_2\text{O}$	20.0	0.529

CH

NICKEL Naphthylamine DiSULFONATES $\text{Ni} \cdot \text{C}_{10}\text{H}_5(\text{NH}_2)(\text{SO}_3)_2$, 2.6.8 and 2.5.7.

100 gms. sat. solution of nickel naphthylamine disulfonate 2.6.8 in water contain 33.2 gms. of the anhydrous compound at 15°. An aqueous solution of the 2.5.7 compound contains 35.5 gms. per 100 gms. sat. solution at 15°.

(Braunschweig, 1922, 1926.)

NICKEL Xylol SELENATES and SULFONATE.

SOLUBILITY OF EACH IN WATER.

(Anschütz, Kallen and Riepenkröger, 1919.)

Compound.	Formula.	t°.	Gms. anhydrous compd. per 100 gms. H_2O .
Nickel o Xylol Selenate.....	$\text{Ni}[(\text{CH}_3)_2(1,2)\text{C}_6\text{H}_3.\text{SeO}_3(4)]_2 \cdot 8\text{H}_2\text{O}$	20	3.95
" p " "	$\text{Ni}[(\text{CH}_3)_2(3,4)\text{C}_6\text{H}_3.\text{SeO}_3(5)]_2 \cdot 7\text{H}_2\text{O}$	15	2.31
" o " Sulfonate.....	$\text{Ni}[(\text{CH}_3)_2(1,2)\text{C}_6\text{H}_3\text{SO}_3(4)]_2 \cdot 6\text{H}_2\text{O}$	16	3.63

NICKEL CYANIDE $\text{Ni}(\text{CN})_2$.

CN One liter sat. solution of nickel cyanide in water contain 0.000535 gm. mol. $\text{Ni}(\text{CN})_2$ at 18°, as determined by E.M.F. measurements.

(Masaki, 1931.)

NICKEL NITROPRUSSIATE $\text{NiFe}(\text{CN})_5\text{NO}$.

One liter sat. solution of nickel nitro prussiate in water contain 0.00006 gm. mol. $\text{NiFe}(\text{CN})_5\text{NO}$ at 20°. (Tomicek and Kubik, 1937.)

A previous determination by Zuccari, 1914, 1915, gave 0.1 gm. $\text{NiFe}(\text{CN})_5\text{NO}$ per liter of water which is about six times the present value.

NICKEL THIOCYANATE $\text{Ni}(\text{SCN})_2$.

100 gms. sat. solution in Water contain 35.48 gms. $\text{Ni}(\text{SCN})_2$ at 25°. (de Smeeder, 1932.) The author also gives results for the system

$\text{Ni}(\text{SCN})_2 + \text{KSCN} + \text{H}_2\text{O}$ and $\text{Ni}(\text{SCN})_2 + \text{Co}(\text{SCN})_2 + \text{H}_2\text{O}$ at 25°.

NICKEL CARBONATE NiCO_3 .

CO One liter H_2O dissolves 7.789×10^{-4} mols. $\text{NiCO}_3 = 0.0925$ gm. at 25°. (Ageno and Valla, 1911.)

NICKEL CARBOXYL.

100 gms. of the aqueous solution saturated at 9.8° contain 2.36 cc. of the vapor = 6.43 milligrams Ni. In blood serum it is $2\frac{1}{2}$ times as soluble. (Armit, 1907.)

NICKEL OXALATE $\text{Ni}(\text{C}_2\text{O}_4) \cdot 2\text{H}_2\text{O}$.

One liter sat. solution in water contain 0.003 gm. NiC_2O_4 at 18° , as determined by electrolytic conductivity. (Scholder, Gadenne and Niemann, 1927.)

SOLUBILITY OF NICKEL OXALATE IN AQUEOUS SOLUTIONS OF FORMIC ACID AT 20° .
(Ledrut and Hauss, 1937.)

The saturated solutions were analyzed by warming on the steam bath with excess of H_2SO_4 to eliminate the HCOOH and titrating with 0.001N KMnO_4 .

Gms. HCOOH per 100 gms. solvent	Gms. NiC_2O_4 per liter sat. sol.	Solid Phase
0.0 ($= \text{H}_2\text{O}$)	0.041	$\text{NiC}_2\text{O}_4 \cdot 2\text{H}_2\text{O}$
25.0	0.022	"
50.0	0.028	"
95.0	0.100 (1)	"
100.0	0.075	"

(1) per 1000 gms. sat. solution. (Aschan, 1913.)

NICKEL CHLORIDE $\text{NiCl}_2 \cdot 6\text{H}_2\text{O}$.SOLUBILITY OF NICKEL CHLORIDE IN WATER.
(Boye, 1934.)

t°	Gms. NiCl_2 per 100 gms. sat. sol.	Solid Phase	t°	Gms. NiCl_2 per 100 gms. sat. sol.	Solid Phase
- 0.5	2.17	Ice	- 9.8	34.1	$\text{NiCl}_2 \cdot 6\text{H}_2\text{O}$
- 3.6	7.88		0	34.8	"
-11.3	15.6		+17.5	37.1 (1)	"
-19.0	20.6		25	39.6 (1)	"
-26.7	24.2		27.9	41.3	"
-35.3	26.9	"	28.8	41.6	" + $\text{NiCl}_2 \cdot 4\text{H}_2\text{O}$
-41.0	29.0		35.0	42.0	$\text{NiCl}_2 \cdot 4\text{H}_2\text{O}$
-45.3	29.9	" + $\text{NiCl}_2 \cdot 7\text{H}_2\text{O}$	50.0	43.2 (1)	"
-40.8	30.0	$\text{NiCl}_2 \cdot 7\text{H}_2\text{O}$	60.0	44.8 (1)	"
-36.1	30.3	"	64.3	46.1	" + $\text{NiCl}_2 \cdot 2\text{H}_2\text{O}$
-34.2	31.3	"	67.6	46.1	$\text{NiCl}_2 \cdot 2\text{H}_2\text{O}$
-33.3	33.8	" + $\text{NiCl}_2 \cdot 6\text{H}_2\text{O}$	75.0	46.3 (1)	"
-29.1	33.8	$\text{NiCl}_2 \cdot 6\text{H}_2\text{O}$	100.2	46.7	"
-20.2	33.9	"	110.4	46.8	"
-14.9	34.0	"	117.9b.pt.	46.9	"

(1) Benrath, 1932.

NICKEL CHLORIDE $\text{NiCl}_2 \cdot 6\text{H}_2\text{O}$.EQUILIBRIUM IN THE SYSTEM NICKEL CHLORIDE, HYDROCHLORIC ACID AND WATER
AT 0° . (Foote, 1923.)

Saturation was secured by constant rotation. The composition of the solid phases was determined by Schreinemakers graphic method.

Gms. per 100 gms. sat. sol.		Solid Phase.	Gms. per 100 gms. sat. sol.		Solid Phase.
NiCl_2	HCl		NiCl_2	HCl	
35.27	0.0	$\text{NiCl}_2 \cdot 6\text{H}_2\text{O}$	4.45	26.23	$\text{NiCl}_2 \cdot 4\text{H}_2\text{O}$
26.71	6.53	"	2.92	28.82	"
15.67	14.09	"	1.37	34.57	"
9.68	18.62	"	1.40	35.03	" + $\text{NiCl}_2 \cdot 2\text{H}_2\text{O}$
6.15	21.70	"	2.29	33.96	" (unstable)
5.30	23.03	"	1.57	34.7	"
3.65	25.74	"	1.06	36.0	$\text{NiCl}_2 \cdot 2\text{H}_2\text{O}$
4.02	26.16	"	0.82	37.22	"
4.56	26.00	" + $\text{NiCl}_2 \cdot 4\text{H}_2\text{O}$	0.43	40.61	"

100 gms. sat. sol. of nickel chloride in selenium oxychloride (SeOCl_2) contain 0.15 gm. NiCl_2 at 25° . (Wise, 1923.)

EQUILIBRIUM IN THE SYSTEM NICKEL CHLORIDE, HYDROCHLORIC
ACID AND WATER.

(Babaev and Archako, 1935.)

Cl

Results at 20° Results at 80°

Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase
HCl	NiCl_2		HCl	NiCl_2	
0.0	38.29	$\text{NiCl}_2 \cdot 6\text{H}_2\text{O}$	0.0	45.96	$\text{NiCl}_2 \cdot 4\text{H}_2\text{O}$
4.20	32.15	"	1.0	44.00	"
11.25	22.87	"	3.82	39.29	"
16.22	16.24	"	6.64	34.86	"
20.51	12.04	"	11.54	28.09	"
21.20	11.60	" + $\text{NiCl}_2 \cdot 4\text{H}_2\text{O}$	15.04	22.79	"
22.07	9.58	$\text{NiCl}_2 \cdot 4\text{H}_2\text{O}$	19.54	16.40	"
24.01	7.38	"	23.20	11.12	"
30.74	2.73	"	26.20	8.63	"

1000 cc. sat. HCl solution dissolve 4 gms. NiCl_2 at 12° . (Ditte, 1881.)100 gms. abs. alcohol dissolve 10.05 gms. NiCl_2 at room temperature.100 gms. abs. alcohol dissolve 53.71 gms. $\text{NiCl}_2 \cdot 6\text{H}_2\text{O}$ at room temperature.

(Böttker, 1897.)

100 gms. abs. alcohol dissolve 2.16 gms. $\text{NiCl}_2 \cdot 7\text{H}_2\text{O}$ at 17° , and 1.4 gms. at 3° .

(de Bruyn, 1892.)

100 gms. saturated solution in glycol contain 16.2 gms. NiCl_2 at room temperature.

(de Coninck, 1905.)

100 cc. anhydrous hydrazine dissolve 8 gms. NiCl_2 at room temp. and solution is colored violet.

(Welsh and Broderson, 1915.)

100 gms. 95% formic acid dissolve 5.9 gms. NiCl_2 at 20.5° .

(Aschan, 1913.)

When 1 gm. of nickel, as chloride, is dissolved in 100 cc. of 10% aq. HCl and shaken with 100 cc. of ether, 0.01 per cent of the Nickel enters the ethereal layer.

(Mylius, 1911.)

NICKEL CHLORATE $\text{Ni}(\text{ClO}_3)_2$.**SOLUBILITY IN WATER.**

(Meusser — Ber. 35, 1419, '02.)

t°.	Gms. $\text{Ni}(\text{ClO}_3)_2$ per 100 Gms. Solution.	Mols. $\text{Ni}(\text{ClO}_3)_2$ per 100 Mols. H_2O .	Solid Phase.	t°.	Gms. $\text{Ni}(\text{ClO}_3)_2$ per 100 Gms. Solution.	Mols. $\text{Ni}(\text{ClO}_3)_2$ per 100 Mols. H_2O .	Solid Phase.
-18	49.55	7.84	$\text{Ni}(\text{ClO}_3)_{2.6}\text{H}_2\text{O}$	48	67.60	16.65	$\text{Ni}(\text{ClO}_3)_{2.4}\text{H}_2\text{O}$
-8	51.52	8.49	"	55	68.78	17.59	"
0	52.66	8.88	"	65	69.05	18.01	"
+18	56.74	10.47	"	79.5	75.50	24.68	"
40	64.47	15.35	"	-13.5	31.85	3.73	Ice
				-9	26.62	2.90	"

Sp. Gr. of solution saturated at + 18 = 1.661.

According to Carlson (1910) 100 gms. sat. sol. in H_2O at 16° contain 64.1 gms. $\text{Ni}(\text{ClO}_3)_2$ and d_{16} of sat. sol. = 1.76.**NICKEL PerCHLORATE** $\text{Ni}(\text{ClO}_4)_2 \cdot 9\text{H}_2\text{O}$.**SOLUBILITY IN WATER.**

(Goldblum and Terlikowski, 1912.)

t°.	d of Sat. Sol.	Gms. $\text{Ni}(\text{ClO}_4)_2$ per 100 Gms. H_2O .	Solid Phase.	t°.	d of Sat. Sol.	Gms. $\text{Ni}(\text{ClO}_4)_2$ per 100 Gms. H_2O .	Solid Phase.
0	...	0	Ice	-21.3	...	92.5	$\text{Ni}(\text{ClO}_4)_{3.9}\text{H}_2\text{O}$
-10.9	...	33.19	"	0	1.573	104.6	$\text{Ni}(\text{ClO}_4)_{3.5}\text{H}_2\text{O}$
-21.3	...	46.68	"	7.5	1.576	106.8	$\text{Ni}(\text{ClO}_4)_{3.5}\text{H}_2\text{O}$
-30.7	...	70	"	18	1.576	110.1	"
-49	Ice + $\text{Ni}(\text{ClO}_4)_{2.9}\text{H}_2\text{O}$	26	1.584	112.2	"
-30.7	...	90	$\text{Ni}(\text{ClO}_4)_{3.9}\text{H}_2\text{O}$	45	1.594	118.6	"

ClO

**SOLUBILITY OF NICKEL PERCHLORATE IN FURFURAL
AND IN CELLOSOLVE AT ABOUT 20°.**

(Chaney and Mann, 1931.)

Solvent	Gms. $\text{Ni}(\text{ClO}_4)_2 \cdot 7\text{H}_2\text{O}$ per 100 cc solvent	Solid Phase
Furfural	60	$\text{Ni}(\text{ClO}_4)_2 \cdot 6\text{H}_2\text{O}$
"	20	$\text{Ni}(\text{ClO}_4)_2 \cdot 2\text{H}_2\text{O}$
Cellosolve (1)	100+	$\text{Ni}(\text{ClO}_4)_2 \cdot 6\text{H}_2\text{O}$
"	35	$\text{Ni}(\text{ClO}_4)_2 \cdot 2\text{H}_2\text{O}$

(1) Monoethyl ether of ethylene glycol.

NICKEL Hexa Antipyrine Per CHLORATE $[\text{Ni}(\text{COC}_{10}\text{H}_{12}\text{N}_2)_6](\text{ClO}_4)_2$.100 cc. sat. sol. of the salt in water contain 17.75 gms. $[\text{Ni}(\text{COC}_{10}\text{H}_{12}\text{N}_2)_6](\text{ClO}_4)_2$ at 20°. (Wilke-Dörfurt and Schliephake, 1929.)

NICKEL FLUORIDE $\text{NiF}_2 \cdot 4\text{H}_2\text{O}$.

SOLUBILITY OF NICKEL FLUORIDE IN WATER.

(Kurtenacker, Finger and Hey, 1933.)

t°	Gms. NiF_2 per 100 gms. sat. sol.	Solid Phase
10	2.49	$\text{NiF}_2 \cdot 4\text{H}_2\text{O}$
20	2.50	"
50	2.50	"
90	2.52	"

100 cc. sat. solution of anhydrous (?) nickelous fluoride in water contain 4.03 gms. NiF_2 at 25° . (Carter, 1928.)

SOLUBILITY OF NICKEL FLUORIDE IN AQUEOUS SOLUTIONS OF HYDROFLUORIC ACID AT 20° .

(Kurtenacker, Finger and Hey, 1933.)

F

Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase
NiF_2	HF		NiF_2	HF	
2.50	0	$\text{NiF}_2 \cdot 4\text{H}_2\text{O}$	11.45	17.46	$\text{NiF}_2 \cdot 4\text{H}_2\text{O}$
7.73	9.25	"	13.72	28.51	"
10.02	12.39	"	13.30	30.10	"

SOLUBILITY OF NICKEL FLUORIDE IN AQUEOUS SOLUTIONS OF AMMONIUM FLUORIDE.

(Kurtenacker, Finger and Hey, 1933.)

Results at 20° Results at 50°

Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase
NiF_2	NH_4F		NiF_2	NH_4F	
1.07	3.4	$\text{NiF}_2 \cdot 4\text{H}_2\text{O}$	1.60	5.0	$\text{NiF}_2 \cdot 4\text{H}_2\text{O}$
0.91	6.4	"	1.04	8.1	"
0.72	9.4	"	0.36	13.1	$\text{NiF}_2 \cdot 2\text{NH}_4\text{F} \cdot 2\text{H}_2\text{O}$
0.51	10.4	$\text{NiF}_2 \cdot 2\text{NH}_4\text{F} \cdot 2\text{H}_2\text{O}$	0.15	17.7	"
0.17	17.1	"	0.10	20.5	"
0.07	23.0	"	0.04	26.2	"
0.02	28.5	"	0.02	32.4	"
0.01	37.4	"	0.01	37.3	"
0.00	41.2	"	0.0	41.5	"

EQUILIBRIUM IN THE SYSTEM NICKEL FLUORIDE, POTASSIUM FLUORIDE AND WATER.

(Kurtzacker, Finger and Hey, 1933.)

Results at 20°

Gms. per 100 gms. sat. sol.	
NiF ₂	KF
1.98	1.21
1.20	3.52
0.80	6.32
0.52	9.64
0.40	12.9
0.01	16.8
0.0	37.5

Solid
Phase

Mixed Crystals

"

"

"

"

"

"

Results at 50°

Gms. per 100 gms. sat. sol.	
NiF ₂	KF
2.01	1.18
1.12	4.30
0.26	9.25
0.03	15.4
0.01	19.2
0.0	27.7
0.0	41.3

Solid
Phase

Mixed Crystals

"

"

"

"

"

"

NICKEL Hexa Antipyrine Boro FLUORIDE $[\text{Ni}(\text{COC}_{10}\text{H}_{12}\text{N}_2)_6](\text{BF}_4)_2$.

100 cc. sat. solution of the salt in water contain 4.8 gm.
 $[\text{Ni}(\text{COC}_{10}\text{H}_{12}\text{N}_2)_6](\text{BF}_4)_2$ at 20°. (Wilke-Dörfurt and Mureck, 1929.)

NICKEL Phospho FLUORIDE $\text{Ni}(\text{PF}_6)_2 \cdot 6\text{NH}_3$.

Solubility results for a long series of organic nickel phospho fluorides in water are given by Lange and Müller, 1930.

NICKEL IODIDE $\text{NiI}_2 \cdot 6\text{H}_2\text{O}$.

SOLUBILITY IN WATER. (Etard, 1894.)

t°.	Gms. NiI ₂ per 100 Gms. Solution.	t°.	Gms. NiI ₂ per 100 Gms. Solution.	t°.	Gms. NiI ₂ per 100 Gms. Solution.
-20	52	25	60.7	60	64.8
0	55.4	30	61.7	70	65
10	57.5	40	63.5	80	65.2
20	59.7	50	64.7	90	65.3

By interpolation the tr. pt. for $\text{NiI}_2 \cdot 6\text{H}_2\text{O} + \text{NiI}_2 \cdot 4\text{H}_2\text{O}$ is at 43°.

NICKEL IODATE $\text{Ni}(\text{IO}_3)_2$.

SOLUBILITY IN WATER.

(Meusser — Ber. 34, 2440, '01.)

t°.	Gms. Ni(IO ₃) ₂ per 100 Gms. Solution.	Mols. Ni(IO ₃) ₂ per 100 Mols. H ₂ O.	Solid Phase.	t°.	Gms. Ni(IO ₃) ₂ per 100 Gms. Solution.	Mols. Ni(IO ₃) ₂ per 100 Mols. H ₂ O.	Solid Phase.
0	0.73	0.033	Ni(IO ₃) ₂ · 4H ₂ O	18	0.55	0.0245	Ni(IO ₃) ₂ · 2H ₂ O (α)
18	1.03	0.045	"	50	0.81	0.035	"
30	1.41	0.063	"	75	1.03	0.045	"
0	0.53	0.023	Ni(IO ₃) ₂ · 2H ₂ O (1)	80	1.12	0.049	"
18	0.68	0.030	"	30	1.135	0.050	Ni(IO ₃) ₂
30	0.86	0.039	"	50	1.07	0.046	"
50	1.78	0.080	"	75	1.02	0.045	"
8	0.52	0.023	Ni(IO ₃) ₂ · 2H ₂ O (2)	90	0.988	0.044	"

(1) α Dihydrate.

(2) β Dihydrate.

NICKEL AMMONIATES of the type $[\text{Ni}(\text{NH}_3)_6] \text{X}_2$.

SOLUBILITY OF SEVERAL NICKEL AMMONIATES IN A MIXTURE OF EQUAL VOLUMES OF AQUEOUS AMMONIA ($d_{22} = 0.95$) AND 96 PER CENT ETHYL ALCOHOL AT 18° (Ephraim and Mosimann, 1922.)

Compound.	Formula.	Gms. compd. per liter sat. sol.	Gm. mols. compd. per liter sat. sol.
Nickel Hexamine Chlorate.....	$[\text{Ni}(\text{NH}_3)_6](\text{ClO}_3)_2$	74.75	0.228
» Nitrate.....	$[\text{Ni}(\text{NH}_3)_6](\text{NO}_3)_2$	44.55	0.156
» Chloride.....	$[\text{Ni}(\text{NH}_3)_6]\text{Cl}_2$	15.39	0.066
» Sulfate.....	$[\text{Ni}(\text{NH}_3)_6]\text{SO}_4$	14.22	0.055
» Thio sulfate...	$[\text{Ni}(\text{NH}_3)_6]\text{S}_2\text{O}_3$	12.87	0.047
» Tetrathionate.	$[\text{Ni}(\text{NH}_3)_6]\text{S}_4\text{O}_6$	11.96	0.031
» Bromide.....	$[\text{Ni}(\text{NH}_3)_6]\text{Br}_2$	7.384	0.023
» Perchlorate...	$[\text{Ni}(\text{NH}_3)_6](\text{ClO}_4)_2$	2.503	0.0069
» Iodide.....	$[\text{Ni}(\text{NH}_3)_6]\text{I}_2$	1.906	0.0046

NICKEL NITRATE $\text{Ni}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$.**SOLUBILITY OF NICKEL NITRATE IN WATER.**

(Sieverts and Schreiner, 1934.)

The following results supplement and correct in certain details, the previous determinations of Funk, 1900.

t°	Gms. NiNO_3 per 100 gms. sat. sol.	Solid Phase	t°	Gms. NiNO_3 per 100 gms. sat. sol.	Solid Phase
NO. - 1.6	8.7	Ice	0	44.2	$\text{Ni}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$
- 6.0	16.2		+20.0	48.5	
-10.3	22.3	"	25	50.0	"
-15.0	27.4	"	30	51.3	"
-22.1	33.4	"	40	54.3	"
-27.8	36.0	" + $\text{Ni}(\text{NO}_3)_2 \cdot 9\text{H}_2\text{O}$	50	58.2	"
-25.4	36.7	$\text{Ni}(\text{NO}_3)_2 \cdot 9\text{H}_2\text{O}$	54	60.0	" + $\text{Ni}(\text{NO}_3)_2 \cdot 4\text{H}_2\text{O}$
-23.7	37.2		60	61.2	
-20.0	38.3	"	75.4	64.3	"
-13.8	40.2	"	80.6	65.6	"
-11.1	41.2	"	85.4	67.2	" + $\text{Ni}(\text{NO}_3)_2 \cdot 2\text{H}_2\text{O}$
-34.1	38.7	Ice + $\text{Ni}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$	90.4	68.2	$\text{Ni}(\text{NO}_3)_2 \cdot 2\text{H}_2\text{O}$
-25.9	40.0		95	68.2	
-20.6	40.5	"	99.5	69.2	"
-13.1	42.6	"	110.5	69.7	"
- 2.9	43.6	"	119.8	70.8	"

EQUILIBRIUM IN THE SYSTEM NICKEL NITRATE, NITRIC ACID AND WATER AT 25°.

(Sieverts and Schreiner, 1934.)

Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase
$\text{Ni}(\text{NO}_3)_2$	HNO_3		$\text{Ni}(\text{NO}_3)_2$	HNO_3	
43.5	7.6	$\text{Ni}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$	5.3	73.9	$\text{Ni}(\text{NO}_3)_2 \cdot 4\text{H}_2\text{O}$
38.9	13.2		5.2	78.6	
34.3	19.1	"	5.0	80.5	"
30.2	24.1	"	4.1	81.6	$\text{Ni}(\text{NO}_3)_2 \cdot 2\text{H}_2\text{O}$
24.7	32.1	"	2.7	84.3	
20.1	40.0	"	1.3	89.8	"
16.0	52.0	" + $\text{Ni}(\text{NO}_3)_2 \cdot 4\text{H}_2\text{O}$	0.3	95.3	"
9.9	60.2	$\text{Ni}(\text{NO}_3)_2 \cdot 4\text{H}_2\text{O}$	0.05	99.5	"
7.4	65.2		(-25°) → 31.5	5.7	
5.9	70.5	"	(+50°) → 0.4	99.3	

100 gms. sat. solution in glycol contain 7.5 gms. $\text{Ni}(\text{NO}_3)_2$ at room temperature.

100 cc. anhydrous hydrazine dissolve 3 gms. $\text{Ni}(\text{NO}_3)_2$ at room temp.

(de Coninck.)

(Welsh and Broderson, 1915.)

NICKEL HYDROXIDE $\text{Ni}(\text{OH})_2$.

SOLUBILITY OF NICKEL HYDROXIDE IN WATER AT 20°.

(Almkvist, 1918.)

Ordinary distilled water containing a little CO_2 was used. The hydroxide was, therefore, probably converted to basic carbonate. Constant stirring was employed. Two liters of saturated solution were used for analysis. 1000 cc. sat. solution contained 0.0127 gm. $\text{Ni}(\text{OH})_2$.

Aqueous ammonia solutions of nickel hydroxide were evaporated in a vacuum desiccator and samples withdrawn at intervals for analysis. The results obtained in duplicate series yielded different curves. For 2 n NH_3 the gms. Ni per liter varied from 0.17 to 0.83. For 4 n NH_3 , the gms. Ni per liter varied from 0.36 to 1.8.

(Bonsdorff, 1904.)

NICKEL Hexamin Per RHENATE $[\text{Ni}(\text{NH}_3)_6](\text{ReO}_4)_2$.

One liter of aqueous ammonia of d. = 0.930 dissolve 33.4 gms. $[\text{Ni}(\text{NH}_3)_6](\text{ReO}_4)_2$ at 26°. (Wilke-Dörfurt and Gunzert, 1933.)

NICKEL SULFIDE NiS

Attention is called by Kolthoff, 1931, to the incorrectness of the results of Weigel, 1906, for the solubility of nickel sulfide in water. It is considered that the values for the solubilities of most sulfides in water are of small or no practical importance. It is recommended that the relations between the solubility and the hydrogen ion and hydrogen sulfide concentrations be expressed by the reaction constant.

1000 cc of sat. solution of nickel sulfide in aqueous 2.0 normal sulfuric acid contain 0.0094 gm. NiS at 20°. (Moser and Rehr, 1924.)

NICKEL SULFATE $\text{NiSO}_4 \cdot 7\text{H}_2\text{O}$.

SOLUBILITY IN WATER. (Steele and Johnson, 1904; see also Tobler, Etard and Mulder.)

t°.	Grams NiSO_4 per 100 Gms.		Solid Phase.	t°.	Grams NiSO_4 per 100 Gms.		Solid Phase.
	Solution.	Water.			Solution.	Water.	
-5	20.47	25.74	$\text{NiSO}_4 \cdot 7\text{H}_2\text{O}$	33.0	30.25	43.35	$\text{NiSO}_4 \cdot 6\text{H}_2\text{O}$
0	21.40	27.22	"	35.6	30.45	43.79	" (blue)
9	23.99	31.55	"	44.7	32.45	48.05	"
22.6	27.48	37.90	"	50.0	33.39	50.15	"
30	29.99	42.46	"	53.0	34.38	52.34	"
32.3	30.57	44.02	"	54.5	34.43	52.50	$\text{NiSO}_4 \cdot 6\text{H}_2\text{O}$
33	31.38	45.74	"	57.0	34.81	53.40	" (green)
34	31.20	45.5	"	60	35.43	54.80	"
32.3	30.35	43.57	$\text{NiSO}_4 \cdot 6\text{H}_2\text{O}$	70	37.29	59.44	"
33.0	30.25	43.35	" (blue)	80	38.71	63.17	"
34.0	30.49	43.83	"	99	43.42	76.71	"

Transition points, hepta hydrate \rightleftharpoons hexa hydrate = 31.5°.

Hexa hydrate (blue) \rightleftharpoons hexa hydrate (green) = 53.3°.

SOLUBILITY OF NICKEL SULFATE IN WATER.

(Vilbrandt and Bender, 1923; Tantzov, 1924, 1925.)

The determinations of Vilbrandt and Bender were made by a *float method*. A glass float calibrated at 25° for a nickel sulfate solution containing a definite concentration of the salt was prepared in advance. By means of this float the volume of water necessary to dilute any solution of higher but unknown concentration of nickel sulfate, to the concentration of the standard solution, could be very accurately determined. From this result the concentration of the unknown solution could be readily calculated. In the following table the results of Tantzov are designated (T).

t°.	Gms. NiSO ₄ per 100 gms. H ₂ O.	Solid Phase.	t°.	Gms. NiSO ₄ per 100 gms. H ₂ O.	Solid Phase.
-4.25....	27.335	NiSO ₄ ·7H ₂ O (Green)	20....	40.09(T)	NiSO ₄ ·6H ₂ O (Blue)
-2.0....	23.366	"	25....	41.56(T)	"
0.0....	26.189	"	30....	43.56(T)	"
3.19....	28.884	"	31.71.	45.299	"
6.0....	30.282	"	35.0..	45.58(T)	"
15.65....	35.491	"	40....	47.533-47.6(T)	"
20.0....	37.70(T)	"	50....	52.171	"
25.....	40.594	"	53.25.	54.041	"
25.....	40.40(T)	"	20....	44.37(T)	NiSO ₄ ·6H ₂ O (Green)
30.....	43.568	"	25....	45.36(T)	"
30.....	43.28(T)	"	30....	46.56(T)	"
35.....	47.03(T)	"	40....	49.16(T)	"
40.....	50.42(T)	"	58.21.	55.389	"
31.55(tr.pt.)	- (T)	+NiSO ₄ ·6H ₂ O (Blue)	60.11.	55.557	"
36.7 (tr.pt.)	- (T)	" (Green)	79.75.	64.476	"
			94.22.	72.597	"

The following recent very careful determinations of the Solubility of Nickel Sulfate in Water are by Rohmer, 1939.

t°	Gms. NiSO ₄ per 100 gms. H ₂ O	sat. sol.	Solid Phase	t°	Gms. NiSO ₄ per 100 gms. H ₂ O	sat. sol.	Solid Phase
-0.9	10.0	9.1	Ice	80.5	67.0	40.1	NiSO ₄ ·6H ₂ O β
-1.6	14.6	12.7	"	90.7	73.6	42.4*	"
-3.4	26.6	21.0	" + NiSO ₄ ·7H ₂ O	100.8	82.0	45.1*	"
0	28.1	21.9	NiSO ₄ ·7H ₂ O	106.0	89.0	47.1*	"
10	33.0	24.9	"	98	79.2	44.2*	" + NiSO ₄ ·5H ₂ O
20	38.4	27.7	"	100	80.0	44.4*	NiSO ₄ ·5H ₂ O
25	41.2	29.2	"	105	82.5	45.2*	"
30	44.1	30.6	"	97	78.5	44.0*	NiSO ₄ ·6H ₂ O α + NiSO ₄ ·4H ₂ O
32.6	45.6	31.3*	"	100	78.6	44.0*	NiSO ₄ ·4H ₂ O
27	43.1	30.1*	NiSO ₄ ·6H ₂ O α	106	80.1	44.4*	"
30.7	44.3	30.7	" + NiSO ₄ ·7H ₂ O	96.4	78.0	43.8*	NiSO ₄ ·6H ₂ O α + NiSO ₄ ·3H ₂ O
35.0	46.0	31.5	NiSO ₄ ·6H ₂ O α	100	77.3	43.6*	NiSO ₄ ·3H ₂ O
40.0	48.2	32.5	"	106	76.8	43.5	"
50.0	52.8	34.6	"	90.3	73.1	42.2*	NiSO ₄ ·6H ₂ O α + NiSO ₄ ·2H ₂ O
58.2	56.6	36.1*	"	104	73.0	42.2*	NiSO ₄ ·2H ₂ O
50.0	53.2	34.7	NiSO ₄ ·6H ₂ O β	84.8	69.3	40.9*	NiSO ₄ ·6H ₂ O α + NiSO ₄ ·H ₂ O
53.8	54.6	35.3	" + NiSO ₄ ·6H ₂ O α	104	69.3	40.9*	NiSO ₄ ·H ₂ O
55	55.0	35.5	NiSO ₄ ·6H ₂ O β				
60	56.9	36.3	"				
70	61.0	37.9	"				

* = Metastable

Additional results for the stable solutions, agreeing in general with the above, are given by Benrath and Theimann, 1934.

EQUILIBRIUM IN THE SYSTEM NICKEL SULFATE, SULFURIC ACID
AND WATER AT 12.5°.

(Montemartini and Losana, 1928.)

d. of sat. sol.	Gms. per 100 gms. sat. sol.		Solid Phase	d. of sat. sol.	Gms. per 100 gms. sat. sol.		Solid
	NiSO ₄	H ₂ SO ₄			NiSO ₄	H ₂ SO ₄	
1.3208	24.06	0.0	NiSO ₄ ·7H ₂ O	1.4076	4.51	45.02	NiSO ₄ ·6H ₂ O
1.2988	18.91	10.25	" "	1.4721	2.62	53.20	" + NiSO ₄ ·2H ₂ O
1.2958	13.62	18.16	NiSO ₄ ·6H ₂ O	1.5450	0.87	63.32	NiSO ₄ ·2H ₂ O
1.3992	8.56	23.42	"	1.6466	0.22	72.61	" + NiSO ₄
1.3236	6.84	32.10	"	1.7728	0.17	81.80	NiSO ₄
1.3598	5.20	40.82	"	1.8430	0.11	98.91	"

EQUILIBRIUM IN THE SYSTEM NICKEL SULFATE, SULFURIC ACID
AND WATER AT 20°.

(Babajewa and Daniluschkina, 1936.)

Gms. per 100 gms. sat. sol.	Solid Phase	Gms. per 100 gms. sat. sol.	Solid Phase
27.53	NiSO ₄ ·7H ₂ O	17.63	NiSO ₄ ·6H ₂ O (blue)
24.13	"	13.72	"
22.64	"	8.56	"
21.14	"	6.71	"
20.60	" + NiSO ₄ ·6H ₂ O	9.56	"
18.60	NiSO ₄ ·6H ₂ O (blue)	0.77	NiSO ₄ ·2H ₂ O

The authors also give similar results for the temperatures 0°, 40° and 80°.

EQUILIBRIUM IN THE SYSTEM NICKEL SULFATE, SULFURIC ACID
AND WATER AT 25°.

(Rohrer, 1939.)

Gms. per 100 gms. sat. sol.	Solid Phase	Gms. per 100 gms. sat. sol.	Solid Phase
29.2	NiSO ₄ ·7H ₂ O	9.2	NiSO ₄ ·4H ₂ O
24.9	"	8.6	"
23.4	" + NiSO ₄ ·6H ₂ O	7.0	NiSO ₄ ·H ₂ O
22.0	NiSO ₄ ·6H ₂ O	4.0	"
19.8	"	2.1	"
14.2	"	1.0	"
8.1	"	0.3	"
9.0	"	0.0	"
9.0	" + NiSO ₄ ·H ₂ O	0.0	"
10.8	"	0.0	" + NiSO ₄
12.5	"	0.0	NiSO ₄
16.9	"	0.0	"
20.1	"		
10.5	" + NiSO ₄ ·4H ₂ O		

This author also gives similar results for the temperatures 0°, 50° and 90° showing both stable and metastable equilibrium at each temperature.

EQUILIBRIUM IN THE SYSTEM NICKEL SULFATE, POTASSIUM SULFATE AND V
AT 25°. (Caven and Johnston, 1926.)

Gms. per 100 gms. sat. sol.		Solid Phase.	Gms. per 100 gms. sat. sol.		Solid Phase.
NiSO ₄ .	K ₂ SO ₄ .		NiSO ₄ .	K ₂ SO ₄ .	
27.94	0.00	NiSO ₄ ·7H ₂ O	15.66	4.75	NiSO ₄ ·K ₂ SO ₄ ·(
27.87	3.82	»	10.15	4.11	»
27.92	6.30	»	3.90	4.15	»
27.90	8.26	»+NiSO ₄ ·K ₂ SO ₄ ·6H ₂ O	1.35	4.93	»
23.09	6.82	NiSO ₄ ·K ₂ SO ₄ ·6H ₂ O	0.33	11.16	»+K ₂ SO ₄
19.33	5.62	»	0.0	10.59	K ₂ SO ₄

Additional results for this system at other temperatures, by Benrath 1932, will be found recorded in connection with potassium sulfate.

EQUILIBRIUM IN THE SYSTEM NICKEL SULFATE, RUBIDIUM
SULFATE AND WATER.

(Benrath, 1932.)

t°	Gms. per 100 gms. sat. sol.		Solid Phase	t°	Gms. per 100 gms. sat. sol.		Solid Phase
	Rb ₂ SO ₄	NiSO ₄			Rb ₂ SO ₄	NiSO ₄	
0	1.84	22.59	NiSO ₄ ·7H ₂ O+1.1.644.5	11.04	6.38	1.1.6	
"	3.25	7.89	1.1.6	54	3.94	35.75	"NiSO ₄ ·(
25	33.7	0.08	Rb ₂ SO ₄ +1.1.6	60	14.6	8.45	1.1.6
"	6.81	3.96	1.1.6	69	16.8	9.73	"
"	2.17	30.9	NiSO ₄ ·7H ₂ O+1.1.688	22.35	12.96	"	
29	2.32	34.6	" + "	100	46.99	0.91	" + Rb ₂ SO ₄
			+ NiSO ₄ ·6H ₂ Oα	"	25.57	14.88	1.1.6
1.1.6 = NiSO ₄ ·Rb ₂ SO ₄ ·6H ₂ O				"	7.98	42.8	"NiSO ₄ ·(

EQUILIBRIUM IN THE SYSTEM NICKEL SULFATE, THALLIUM SULFATE AND WATER.
(Benrath, 1932.)

t°	Gms. per 100 gms. sat. sol.		Solid Phase	t°	Gms. per 100 gms. sat. sol.		Solid Phase
	Tl ₂ SO ₄	NiSO ₄			Tl ₂ SO ₄	NiSO ₄	
0	2.69	0.16	Tl ₂ SO ₄ +1.1.6	46	5.77	1.77	1.1.6
"	1.68	0.51	1.1.6	"	1.55	32.62	"NiSO ₄ ·6H ₂
"	0.63	21.30	"NiSO ₄ ·7H ₂ O	55	7.30	2.25	1.1.6
25	5.15	0.33	"Tl ₂ SO ₄	"	2.28	33.85	"NiSO ₄ ·6H ₂
"	3.20	1.01	1.1.6	80	14.65	3.15	"Tl ₂ SO ₄
"	0.89	27.92	"NiSO ₄ ·7H ₂ O	"	13.42	4.13	"
30	2.28	33.85	" + "	"	4.32	37.99	"NiSO ₄ ·6H ₂
			NiSO ₄ ·6H ₂ Oα	100	20.08	7.34	"Tl ₂ SO ₄
46	8.29	0.85	1.1.6+Tl ₂ SO ₄	"	7.03	41.45	"NiSO ₄ ·6H ₂

SOLUBILITY OF NICKEL SULFATE IN AQUEOUS SOLUTIONS OF METHYL
ALCOHOL AT 14°.
(de Bruyn, 1903.)

Small test tubes of 4-6 cc. capacity were used. They were almost completely filled with the salt and solvent and placed in the bath in an inclined position with salt occupying the upper part of the tube. This caused a "spontaneous circulation of the solvent." The solutions were analyzed by precipitating NiO with KOH at the boiling point, in porcelain vessels.

Wt. Per cent CH ₃ OH in Solvent.	Gms. NiSO ₄ per 100 Gms. Sat. Sol. in Contact with:			
	NiSO ₄ ·7H ₂ O as Solid Phase.	NiSO ₄ ·6H ₂ O α as Solid Phase.	NiSO ₄ ·6H ₂ O β as Solid Phase.	NiSO ₄ ·4H ₂ O as Solid Phase.
0 (H ₂ O)	26.4	26 (low)	27.2	25.1
10	19.7	22 (?)	20.4	...
20	13.1	14.7	14	14.8
30	6.8	6.6	7.5	...
40	2.8	2.4	3.1	...
50	1.3	1	1.4	1.4
60	0.8	0.4	0.6	...
70	0.6	0.2	0.4	...
80	0.65	0.2	0.4	0.66
85	1.5	0.3	0.7	...
90	5.7	1.2	2.5	...
95	11	6	9 (?)	...
100	16.8	12.4 (low)	15.7 (low)	7.38

NiSO₄·6H₂O α is greenish blue. NiSO₄·6H₂O is more greenish than the α salt.

SO

SOLUBILITY OF NiSO₄·3CH₃OH·3H₂O IN AQUEOUS CH₃OH AT 14°.
(de Bruyn, 1903.)

Wt. Per cent CH ₃ OH.	Gms. NiSO ₄ per 100 Gms. Sat. Sol.	Wt. Per cent CH ₃ OH.	Gms. NiSO ₄ per 100 Gms. Sat. Sol.
85	1.93	90	0.70
86	1.73	92.5	0.50
87	1.48	95	0.455
88	1.25	97.5	0.77
89	1.01	100	3.72

Approximately two hours were allowed for attainment of equilibrium.

In solutions containing more than 15% H₂O the salt is gradually transformed to NiSO₄·6H₂O β.

100 gms. absolute ethyl alcohol dissolve 1.4 gm. NiSO₄·7H₂O at 4° and 2.2 gms. at 17°.

(de Bruyn, 1892.)

100 gms. sat. solution in glycol contain 9.7 gms. NiSO₄ at room temp.

(de Coninck, 1905.)

SOLUBILITY OF NICKEL SULFATE IN ABSOLUTE METHYL AND ETHYL ALCOHOLS.

(Gibson, Driscoll and Jones, 1929.)

Results for Methyl Alcohol

Results for Ethyl Alcohol

t°	Gms. NiSO ₄ per 100 gms. CH ₃ OH	Solid Phase
15	0.061	NiSO ₄
25	0.081	"
35	0.110	"
45	0.157	"
55	0.222	"

t°	Gms. NiSO ₄ per 100 gms. C ₂ H ₅ OH	Solid Phase
15	0.017	NiSO ₄
35	0.020	"
45	0.022	"
55	0.025	"

OXYGEN O₂.

SOLUBILITY IN WATER. (Winkler, 1891; Bohr and Rock, 1891.)

t°.	Coef. of Absorption β .		g.	t°.	Coef. of Absorption β .		g.
0	0.0489*	0.0496†	0.00695	40	0.0231*	0.0233†	0.00308
5	0.0429	0.0439	0.00607	50	0.0209	0.0207	0.00266
10	0.0380	0.0390	0.00537	60	0.0195	0.0189	0.00227
15	0.0342	0.0350	0.00480	70	0.0183	0.0178	0.00186
20	0.0310	0.0317	0.00434	80	0.0176	0.0172	0.00138
25	0.0283	0.0290	0.00393	90	0.0172	0.0169	0.00079
30	0.0261	0.0268	0.00359	100	0.0170	0.0168	0.00000

* W.

† B. and B.

β = the Bunsen Coefficient of Absorption, which shows the volume of gas (reduced to 0° and 760mm pressure) absorbed by 1 volume of liquid when the pressure of the gas itself minus the vapor tension of the liquid amounts to 760mm.

g = the weight of gas in grams which is dissolved by 100 gms. of the pure solvent at the indicated temperature and a total pressure (that is, partial pressure of the gas plus the vapor pressure of the liquid) of 760mm.

According to determinations by Fox (1909a), which agree satisfactorily with the above, the solubility of oxygen in water is expressed by the formula:

$$1000 \times \text{abs. coef. } \beta = 49.239 - 1.3440t + 0.28752t^2 - 0.0003024t^3.$$

References to more recent papers on the solubility of oxygen are given by Coste (1917, 1918).

SOLUBILITY OF THE OXYGEN OF AIR IN WATER.

t°.	5.2°.	5.65°.	14.78°.	24.8°.
Solubility *	8.856	8.744	7.08	5.762

* cc. Oxygen per 1000 cc. H₂O saturated with air at 760 mm.

SOLUBILITY OF OXYGEN IN WATER.

A table showing the solubility of oxygen in water in contact with air at various temperatures between 5° and 30° and at absolute pressures from 0 to 760 mm. mercury is given by White, 1919. The results are based upon the tables of Roscoe and Lunt and Henry's law. They are given in terms of milligrams of oxygen per liter and are intended for practical application in industrial problems.

Extensive data upon the rate of solution of atmospheric oxygen and nitrogen in water are given in a series of papers by Adeney and Becker 1916-1920, 1919, 1920 and 1921. See also remarks under Nitrogen, p. 1317.

100 cc. H₂O dissolve 3.0 cc. oxygen (reduced to 0° and 760 mm.) at 21°.

(Venable and Fuwa, 1922.)

Experiments made by Morgan and Richardson, 1930, showed that the Winkler analytical method modified by using oxygen instead of air, gives the same results for the solubility of oxygen in water as that based upon measurement of loss of volume of oxygen in contact with water. It was also shown by experimental determinations that the solubility of oxygen in water obeys Henry's Law at pressures between 175 and 760mm. The solubility of oxygen at 25° and 760mm pressure was found to be 0.0408 gm. O₂ per liter of water.

OXYGEN

The solubility of Oxygen in Water at 25° in terms of the Bunsen Absorption Coefficient (β above) was found by Orcutt and SeEVERS, 1936, to be 0.0281. The authors made use of the Van Slyke-Neill manometric apparatus which is based upon the principal of extracting the gas from the solvent and measuring its pressure. By means of a special technique and method of calculating the correction for unextracted gas, this becomes a simple method of determining the solubility of any gas in any liquid without the aid of previously determined constants.

SOLUBILITY OF OXYGEN IN WATER AND OTHER SOLVENTS AT 25°.

(Frollich, Tauch, Hogan and Peer, 1931.)

The determinations were made by shaking the solvent and oxygen together at various pressures in a 2 liter steel cylinder at 25° and after attainment of equilibrium withdrawing a sample of the saturated solution over mercury in one of three burets, so designed that the volumes could be measured with the same degree of accuracy at any ratio of gas to liquid. The results show that if the gas does not form a chemical compound with the solvent it follows Henry's Law over a wide pressure range within the limits of error allowed in engineering calculations. The solubility may for practical purposes be considered a linear function of the absolute pressure. In the case of the following results for oxygen, y is the volume of O_2 at 25° and 1 atmosphere per unit volume of liquid, and x is the absolute pressure in atmospheres.

Solvent	Pressure Range in atmospheres	Solubility Equation
Water	0 - 70	$y = 0.028x$
Formic Acid	0 - 70	$y = 0.047x$
Carbon Tetrachloride	0 - 70	$y = 0.031x$
Pentane	0 - 100	$y = 0.576x$
Gas Oil (d. = 0.8319)	0 - 70	$y = 0.154x$

SOLUBILITY OF OXYGEN IN SEA WATER.

(Fox, 1909a.)

Before using the sample of sea water for the solubility determinations, it was found necessary to add acid, otherwise the CO_2 could not be boiled out or the precipitation of neutral carbonates prevented. The very small amount of acid was titrated back, using phenolphthaleine as indicator.

Results in terms of cc. of oxygen absorbed by 1000 cc. of sea water from a free dry atmosphere at 760 mm. pressure.

The calculated formula expressing the solubility is: $1000 a = 10.291 - 0.2809 t + 0.006009 t^2 + 0.0000632 t^3 - Cl (0.1161 - 0.003922 t + 0.0000631 t^2)$.

Parts Chlorine per 1000.	$t^{\circ} = 0^{\circ}$.	4° .	8° .	12° .	16° .	20° .	24° .	28° .
0	10.29	9.26	8.40	7.68	7.08	6.57	6.14	5.75
4	9.83	8.85	8.04	7.36	6.80	6.33	5.91	5.53
8	9.36	8.45	7.68	7.04	6.52	6.07	5.67	5.31
12	8.90	8.04	7.33	6.74	6.24	5.82	5.44	5.08
16	8.43	7.64	6.97	6.43	5.96	5.56	5.20	4.86
20	7.97	7.23	6.62	6.11	5.69	5.31	4.95	4.62

A recalculation of Fox's determinations to parts per million, with correction for vapor pressure, is published by Whipple and Whipple (1911).

Additional data on the solubility of atmospheric oxygen in sea water are given by Clowes and Biggs (1904).

Data for the solubility of oxygen in water under pressures up to 10 atmospheres are given by Cassuto (1913). The solubility increases at a somewhat slower rate than proportional to the pressure.

SOLUBILITY OF OXYGEN IN AQUEOUS SALT SOLUTIONS AT 25° .

(MacArthur, 1916.)

Aq. Salt Solution.	d_{25} Aq. Solution.	cc. oxy- gen per Liter.	Aq. Salt Solution.	d_{25} Aq. Solution.	cc. Oxy- gen per Liter.	Aq. Salt Solution.	d_{25} of Solution.	cc. Oxy- gen per Liter.
Dist. H_2O	1	5.78	0.25 n KBr	1.019	5.29	0.125 n NaBr	1.007	5.65
0.125 n NH_4Cl	1.0015	2.31	2 n "	1.079	3.27	0.25 n "	1.017	5.52
0.25 n "	1.0025	1.16	4 n "	1.162	1.84	0.50 n "	1.036	5.15
1 n "	1.014	0.07	0.125 n KCl	1.003	5.52	1 n "	1.075	4.47
0.125 n BaCl_2	1.019	5.40	0.25 n "	1.0086	5.30	2 n "	1.150	3.37
0.25 n "	1.042	5.04	0.50 n "	1.020	4.98	3 n "	1.219	2.57
0.50 n "	1.082	4.27	1 n "	1.042	4.26	4 n "	1.305	2.02
1 n "	1.177	3.10	2 n "	1.086	3.21	6 n "	1.455	1.28
0.25 n CaCl_2	1.022	5.08	3 n "	1.134	2.36	0.125 n NaCl	1.0022	5.52
1 n "	1.084	3.71	4 n "	1.170	1.86	0.25 n "	1.0067	5.30
5 n "	1.34	2.14	0.125 n KI	1.013	5.65	0.50 n "	1.017	4.92
0.125 n CsCl	1.014	5.67	0.25 n "	1.027	5.49	1 n "	1.038	4.20
0.125 n LiCl	1.0004	5.63	0.50 n "	1.056	5.20	2 n "	1.075	3.05
0.50 n "	1.0091	5.17	1 n "	1.116	4.75	3 n "	1.112	2.24
1 n "	1.021	4.59	2 n "	1.23	3.77	4 n "	1.149	1.62
2 n "	1.044	3.63	5 n "	1.46	1.81	0.125 n Na_2SO_4	1.014	5.04
3 n "	1.113	1.97	0.25 n KNO_3	1.015	5.49	0.25 n "	1.032	4.60
4 n "	1.220	1.12	0.50 n "	1.029	5.11	0.50 n "	1.063	3.97
0.125 n MgCl_2	1.011	5.35	1 n "	1.059	4.61	1 n "	1.130	3
0.50 n "	1.044	4.37	2 n "	1.110	3.65	0.125 n Sucrose	1.015	5.40
1 n "	1.085	3.18	0.125 n K_2SO_4	1.016	5.11	0.25 n "	1.033	4.82
2 n "	1.160	2.22	0.25 n "	1.032	4.66	0.50 n "	1.063	4.39
4 n "	1.284	0.78	0.5 n "	1.060	3.89	1 n "	1.147	3.20
5 n "	1.343	0.54	0.125 n RbCl	1.0094	5.65	2 n "	1.336	1.84

SOLUBILITY OF OXYGEN IN WATER AND IN AQUEOUS SOLUTIONS OF ACIDS,
BASES AND SALTS. (Geffcken, 1904.)

Aq. Solution of:	Concentration per Liter.		Solubility of Oxygen.*	
	Gram Equiv.	Grams.	$_{18^{\circ}}$	$_{25^{\circ}}$
Water alone	...	...	0.0363	0.0308
Hydrochloric Acid	0.5	18.22	0.0344	0.0296
"	1.0	36.45	0.0327	0.0287
"	2.0	72.90	0.0299	0.0267
Nitric Acid	0.5	36.52	0.0348	0.0302
"	1.0	63.05	0.0336	0.0295
"	2.0	126.10	0.0315	0.0284
Sulphuric Acid	0.5	24.52	0.0338	0.0288
"	1.0	49.04	0.0319	0.0275
"	2.0	98.08	0.0335	0.0251
"	3.0	147.12	0.0256	0.0229
"	4.0	196.16	0.0233	0.0209
"	5.0	245.20	0.0213	0.0194
Potassium Hydroxide	0.5	28.08	0.0291	0.0252
"	1.0	56.16	0.0234	0.0206
Sodium Hydroxide	0.5	20.03	0.0288	0.0250
"	1.0	40.06	0.0231	0.0204
"	2.0	80.12	0.0152	0.0133
Potassium Sulphate	0.5	43.59	0.0294	0.0253
"	1.0	87.18	0.0237	0.0207
Sodium Chloride	0.5	29.25	0.0308	0.0262
"	1.0	58.5	0.0260	0.0223
"	2.0	119.0	0.0182	0.0158

* l = the Ostwald Solubility Expression which shows the ratio of the volume (v) of gas absorbed at any pressure and temperature, to the volume (V) of the absorbing liquid. Thus $l = \frac{v}{V}$. The Ostwald Expression and the Bunsen Absorption Coefficient (see table for solubility of oxygen in water) are related thus,

$$l = \beta (1 + 0.00367 t), \quad \beta = l \div (1 + 0.00367 t)$$

SOLUBILITY OF OXYGEN IN AQUEOUS POTASSIUM CYANIDE SOLUTIONS AT 20°.
(Maclaurin, 1893.)

Gms. KCN per 100 gms. sol.	1	10	20	30	50
Coefficient of absorption β	0.029	0.018	0.013	0.008	0.003

SOLUBILITY OF OXYGEN IN AQUEOUS SULFURIC ACID SOLUTIONS.

Results at 21°. (Bohr, 1910.)				Results at 20°. (Christoff, 1906.)	
Normality of H_2SO_4 .	Absorp. Coef. β .	Normality of H_2SO_4 .	Absorp. Coef. β .	Wt. % H_2SO_4 .	Ostwald Solubility Expression l_{20} .
0	0.0310	24.8	0.0103	0	0.03756
4.9	0.0195	29.6	0.0117	35.82	0.01815
8.9	0.0155	34.3	0.0201	61.62	0.01407
10.7	0.0143	35.8 (=96%)	0.0275	95.60	0.03303
20.3	0.0119				

SOLUBILITY OF OXYGEN IN AQUEOUS SOLUTIONS OF:

Chloral Hydrate at 20°. (Müller, 1912-13.)

Gms. $\text{CCl}_3\text{CH(OH)}_2$ per 100 Gms. Aq. Sol.	d_{20} of Aq. Sol.	Abs. Coef. β (Bunsen) at 20°.
16.9	1.0798	0.02795
32	1.1630	0.02495
52.9	1.2935	0.02325
61.08	1.354	0.02410
65.5	1.382	0.02580
71.4	1.4404	0.02730
78	1.46	0.03280

Glycerol at 15°. (Müller, 1912-13.)

Gms. $(\text{CH}_2\text{OH})_2\text{CHOH}$ per 100 Gms. Aq. Sol.	d of Aq. Sol.	Abs. Coef. β (Bunsen) at 15°.
20.5	$d_{12.5} = 1.0509$	0.02742
25	$d_{13} = 1.0621$	0.02521
37.3	$d_{14.5} = 1.0957$	0.02022
45	$d_{12.5} = 1.1161$	0.01744
52	$d_{12.5} = 1.1351$	0.01570
71.5	$d_{12.5} = 1.1908$	0.00950
88.5	$d_{13.5} = 1.236$	0.00886

SOLUBILITY OF OXYGEN IN AQUEOUS SOLUTIONS OF:

Glucose at 20°. (Müller, 1912-13.)

Gms. $\text{C}_6\text{H}_{12}\text{O}_6$ per 100 Gms. Aq. Sol.	d_{20} of Aq. Sol.	Abs. Coef. β (Bunsen) at 20°.
10.84	1.0413	0.02690
20.7	1.0835	0.02250
33.8	1.1370	0.01815
51.9	1.2295	0.01390
58.84	1.2649	0.01250

Cane Sugar at 15°. (Müller, 1912-13.)

Gms. $\text{C}_{12}\text{H}_{22}\text{O}_{11}$ per 100 Gms. Aq. Sol.	d_{15} of Aq. Sol.	Abs. Coef. β (Bunsen) at 15°.
12.1	1.0482	0.02969
24.38	1.1022	0.02396
28.44	1.1205	0.02181
42.96	1.1938	0.01600
50	1.2318	0.01359

INFLUENCE OF ANESTHETICS UPON THE SOLUBILITY OF OXYGEN IN OLIVE OIL.
(Hamberger, 1911.)

Name and Conc. of Narcotic Added to the Oil.	Solubility of Oxygen in:		Name and Conc. of Narcotic Added to the Oil.	Solubility of Oxygen in:	
	Pure Solvent.	Narcotic Solution.		Pure Solvent.	Narcotic Solution.
Sulfonal (0.8 per 100)	9.69	4.55	Monochlorhydrine (5 per 100)	9.10	7.50
"	9.69	5.68	" (2.5 ")	9.10	7.50
"	9.69	6.25	" (1.25 ")	9.10	7.90
Trional (saturated)	9.10	4.55	Dichlorhydrine (10 ")	9.10	7.96
"	9.10	5.68	" (5 ")	9.10	8
Tetronal (2 per 100)	9.67	9.10	Phenylurethan (5 ")	8.53	6.25
"	9.67	9.20	" (2.5 ")	8.53	7.50
Camphor (10 per 100)	8.53	7.96			

Data for the solubility of oxygen in liquid air are given by Baly (1900).

Data for the solubility of oxygen in hemoglobin are given by Jolin (1889).

Data for the solubility of oxygen in defibrinated ox-blood and ox-serum, at pressures varying from 760 to about 1400 mm. Hg, are given by Findlay and Creighton (1911).

SOLUBILITY OF OXYGEN IN PLASMA AND IN BLOOD.

(O'Brien and Parker, 1922, quoted from Bohr, 1905.)

Solvent.	Coef. abs. α (cc. O_2 per cc. solvent, at 0° and 760 mm.)	
	at 15°.	at 38°.
Blood plasma.....	0.033	0.023
Whole blood.....	0.031	0.022
Blood corpuscles.....	0.025	0.019

SOLUBILITY OF OXYGEN IN BLOOD AT 38°.

(Sendroy, Dillon and Van Slyke, 1934.)

The authors point out that the result reported by Bohr was not directly determined but estimated on the assumption that since his experiments showed hydrogen to be only 92 percent as soluble in blood as in water, oxygen would also have the same "relative solubility". The authors, have therefore, made direct determinations of the solubility of oxygen in blood and also determined the effect of its various constituents upon this solubility. The Van Slyke-Neil (1924) manometric gas apparatus was used (see preceding remarks in connection with results for the solubility of oxygen in water by Orcutt and Seevers). The results are given in terms of the Runsen Abs. Coef. as defined in connection with the preceding table for the solubility of oxygen in water.

Solvent	Oxygen Abs. Coef. β
Water	0.02323
Aq. 0.155 normal NaCl	0.02211
Plasma	0.0209
Cells	0.0261
Whole Blood of normal hemoglobin content	0.0230 (0.034 at 20°)
Hemoglobin	0.0280*

*This result shows the cc. O_2 taken up by 1 gm. of dissolved hemoglobin when the gas tension is 760mm.

100 cc. rubber dissolve 7.3 cc. oxygen (reduced to 0° and 760 mm.) at 21°. The gas dissolved by a given amount of air free rubber was pumped out with a Tüpler pump and measured over mercury. (Venable and Fuwa, 1922.)

SOLUBILITY OF OXYGEN IN ETHYL ALCOHOL, METHYL ALCOHOL AND IN ACETONE.

(Timofejew — Z. physik. Ch. 6, 151, '90; Levi — Gazz. chim. ital. 31, II, 513, '01.)

t°.	In Ethyl Alcohol of 90.7% (T.).		In Methyl Alcohol (L.)	In Acetone (L.)
	β .	β' .	$l =$	$l =$
0	0.2337	0.2297	0.31864	0.2997
5	0.2301	0.2247	0.30506	0.2835
10	0.2266	0.2194	0.29005	0.2667
15	0.2232	0.2137	0.27361	0.2493
20	0.2201	0.2073	0.25574	0.2313
25	0.2177 (24°)	0.2017 (24°)	0.23642	0.2127
30	...	...	0.21569	0.1935
40	...	...	0.16990	0.1533
50	...	...	0.11840	0.1057

β and l are defined in the preceding pages. β' shows the volume of gas (reduced to 0° and 760mm) which is absorbed by one volume of the liquid when the barometer indicates 760mm pressure.

The formulæ expressing the solubility of oxygen in methyl alcohol and in acetone as shown in the above table are as follows:

In Methyl Alcohol $l = 0.31864 - 0.002572 t - 0.00002866 t^2$.

In Acetone $l = 0.2997 - 0.00318 t - 0.000012 t^2$.

The formula expressing the absorption coefficient of oxygen in ethyl alcohol is $\beta = 0.23370 - 0.00074688 t + 0.000003288 t^2$.

SOLUBILITY OF OXYGEN IN AQUEOUS ALCOHOL AT 20° AND 760 MM.
(Lubarsch, 1889)

Wt. Per cent Alcohol.	Vol. Per cent Absorbed O.	Wt. Per cent Alcohol.	Vol. Per cent Absorbed O.	Wt. Per cent Alcohol.	Vol. Per cent Absorbed O.
0	2.98	23.08	2.52	50	3.50
9.09	2.78	28.57	2.49	66.67	4.95
16.67	2.63	33.33	2.67	80	5.66

SOLUBILITY OF OXYGEN IN PETROLEUM. COEFFICIENT OF ABSORPTION AT
10° = 0.229, AT 20° = 0.202.
(Gniewasz and Walfisz, 1887.)

SOLUBILITY OF OXYGEN ETHYL ETHER.
(Christoff, 1912.)

Results in terms of the Ostwald Solubility Expression, $l_0 = 0.4235$, $l_{10} = 0.4215$.

The Solubility of Oxygen in Benzene at 25° in terms of the Ostwald Solubility Expression was found by Morgan and Pyne, 1930 to be, $l = 0.2079$.

One liter of cyclohexanol ($C_6H_{11}OH$) dissolve 193.5cc Oxygen at 26° and 766mm. (Cauquil, 1927.)

The coefficient of absorption of O_2 in mineral oil ($d = 0.868$ at 27°, viscosity 285 at 100°F (Saybolt) and f. pt. = -37°) was found by Kubie, 1927, using the Van Slyke-Neil, 1924, apparatus, to be 0.134cc O_2 (reduced to 0° and 760mm) per 1.0cc of oil at 24° and 760mm.

SOLUBILITY OF OXYGEN IN SEVERAL ORGANIC SOLVENTS.
(Horvut, 1931, 1932.)

t°	Solubility of O_2 in terms of the Ostwald Expression l in :					
	CCl_4	C_6H_5Cl	C_6H_6	$(CH_3)_2CO$	$CH_3CO_2CH_3$	$(C_2H_5)_2O$
-78	—	—	—	0.2147	0.1901	0.4505
-60	—	—	—	0.2175	0.1987	0.4329
-40	—	—	—	0.2253 (-41.3)	0.2126	0.4244
-20	—	—	—	0.2385	0.2288	0.4247
0	0.2865	0.1748	—	0.2550	0.2488	0.4325
+10	0.2926	0.1804	0.2091	0.2649	0.2583	—
20	0.2996	0.1863	0.2186	0.2736	0.2703 (21.85)	0.4511
25	0.302	0.189	0.223	0.280	0.273	0.455
30	0.3056	0.1915	0.2281	0.2846	0.2789	—
40	0.3124	0.1974	0.2371	0.2954	0.2877	—
50	0.3196	0.2031	0.2483	—	—	—
60	0.3246	0.2094	0.2576	—	—	—
70	—	0.2163	—	—	—	—
80	—	0.2214	—	—	—	—

SOLUBILITY OF OXYGEN IN VARIOUS ORGANIC SOLVENTS.

(Fischer and Pfeleiderer, 1922.)

The determinations were made by two procedures for which highest accuracy is not claimed but which yield comparative values of much interest. (1) An autoclave of known volume is nearly filled with a measured amount of the solvent. The apparatus is shaken and oxygen introduced until a constant pressure of the gas is reached. The pressure is then released to one atmosphere and the volume of liberated gas is measured. By calculating from the total pressure, the volume of free space above the solvent and the volume of liberated gas, a value for the solubility is obtained. The correction for vapor pressure of solvent is relatively small by this method. (2) The solvent is saturated in an autoclave under known pressure by means of a gas outlet under the liquid. A sample of the saturated solution is withdrawn, its volume or weight determined and its dissolved gas released and measured in a gas buret.

Solvent.	<i>d</i> of solvent.	Vapor pressure of solvent		<i>t</i> ° of saturation.	Abs. coef. α .	Solubility <i>l</i> (Ostwald).
		mm.	<i>t</i> °.			
Water.....	1.00	19	21.3	20	0.021	0.023
Aq. 0.1 <i>n</i> KOH.....	1.004	18	20.3	20	0.024	0.026
Petroleum Ether (b. pt. $\approx 65^\circ$)..	0.668	348	18.5	18.5	0.409	0.436
Benzine (b. pt. 65° - 100°)....	0.709	115	20	18	0.292	0.312
Com. Petroleum.....	0.809	4.4	19	18	0.159	0.170
Paraffine Oil.....	0.8805	—	17	18	0.114	0.122
Chloroform.....	1.49	136	16	16	0.205	0.217
Carbon Tetrachloride.....	1.595	86	17.8	18	0.230	0.245
Acetylene » ($C_2H_2Cl_2$)..	1.602	7	18	18	0.100	0.107
Methyl Alcohol.....	0.792	96	20	18.5	0.175	0.187
Ethyl Alcohol (96 %'o).....	0.809	(35-40)	20	20	0.143	0.154
Amyl Alcohol (iso).....	0.812	2	17	16	0.163	0.173
Acetone.....	0.795	165	18	19	0.207	0.222
Ethyl Ether.....	0.718	434	20.2	20.2	0.415	0.446
Ethyl Acetate.....	0.868	73	20	20	0.163	0.175
Benzene.....	0.8785	74.5	19.8	19	0.163	0.174
Toluene.....	0.864	21	18.5	18	0.168	0.179
Xylene (Com.).....	0.865	8.4	16	16	0.169	0.179
Nitrobenzene.....	1.202	—	20	18	0.070	0.075
Tetra hydro naphthalene (Tetralin)..	0.98	—	—	17	0.094	0.100
Pyridine.....	0.981	12	18.5	18	0.099	0.105

The Abs. Coef. α is the volume of gas dissolved in 1 cc. of solvent when its partial pressure is 1 atmosphere (reduced to normal conditions of 0° and 760 mm.). The Ostwald solubility expression *l* is the volume of gas per 1 volume of liquid, on the basis of Henry's law, measured at the saturation temperature. The results for water are probably in error due to removal of oxygen by oxidation of the iron of the autoclave.

SOLUBILITY OF OXYGEN IN LIQUID SULFUR DIOXIDE.

(Dornie and Ferguson, 1939.)

The determinations were made in an apparatus which permitted measurements under static and under circulating conditions. An equation for the variation of absorption with pressure was calculated and from this the following mean values were derived.

t°	cc O ₂ (at 0° and 760mm) dissolved by 1 gm. SO ₂ at 1 atmosphere pressure	t°	cc O ₂ (at 0° and 760mm) dissolved by 1 gm. SO ₂ at 1 atmosphere pressure
-20	25	10	183
-10	50	20	331
0	98	30	575

The solubility of oxygen and other gases in Metals has been extensively studied. A very complete bibliography of this work and of gas solubility is general is given in Landolt and Börnstein "Tabellen", 5th edition, 3rd supplement, first part, 1935.

OZONE O₃.

SOLUBILITY IN WATER.

(von Maillert, 1894; Carius; Schöne, 1873.)

t°.	W.	G.	R.	t°.	W.	G.	R.
0	39.4	61.5	0.641	27	13.9	51.4	0.270
6	34.3	61	0.562	33	7.7	39.5	0.195
11.8	29.9	59.6	0.500	40	4.2	37.6	0.112
13	28	58.1	0.482	47	2.4	31.2	0.077
15	25.9	56.8	0.456	55	0.6	19.3	0.031
19	21	55.2	0.381	60	0	12.3	0

W = milligrams ozone dissolved per liter water. G = milligrams ozone in one liter of the gas phase above the solutions. R = ratio of the dissolved to undissolved ozone ($W \div G$).

The experiments of Schöne (See Above) were repeated by Inglis (1903). "The results confirm Schöne's experiments and indicate that ozone, when passed through water, is partly decomposed."

According to Moufang (1911) the solubility of ozone in distilled water ranges from about 10 milligrams per liter at 2° to about 1.5 milligrams per liter at 28°. The solubility is greatly affected by other substances in solution. Small amounts of acids increase the solubility and render the aqueous solution of the ozone more permanent. Alkalis decrease the solubility. Neutral salts (*i.e.*, calcium sulfate) increase the solubility.

SOLUBILITY OF OZONE IN DILUTE SULFURIC ACID.

(Rothmund, 1912.)

The explanation of the discrepancies concerning the solubility of ozone in water is that the ozone quickly decomposes as the saturation point is reached. Rothmund, therefore, determined the solubility in dilute H₂SO₄ in which decomposition takes place much more slowly than in pure water. At 0° the absorption coef. β (Bunsen, see p.1252) in 0.1 N H₂SO₄ is 0.487. The coef. remains practically the same when the concentration of the ozone is changed over a wide range, hence Henry's Law holds for ozone. The dissolved ozone has the same molecular weight as the gaseous. The solubility depression which ozone experiences through 0.1 N H₂SO₄ is calculated as 1.5%. Therefore, by extrapolation, it is calculated that the abs. coef. β of ozone in H₂O at 0°, is 0.494.

SOLUBILITY OF OZONE IN WATER.

(Bräer and Perrottet, 1939.)

Conc. of Ozone, in gaseous phase	Bunsen Coef. of Absorption β at:	
	3.5°	19.8°
0.3	0.463	—
1.2	0.506	—
6.0	0.475	0.308
6.3	0.470*	—
7.0	—	0.334*
9.0	0.473*	—
	average 0.480	0.323

In these cases the liquid was previously put in contact with a gas phase richer in ozone and equilibrium was thus approached from above.

The Bunsen Coefficient β of ozone in aq. NaCl solution containing 35 gms. NaCl per liter was found to be 0.24 at 3.5° and 0.17 at 19.8°.

Additional results for the solubility of ozone in water and aqueous solutions of sulfuric acid are given by Kachtanow and Obstchouk, 1937.

SOLUBILITY OF OZONE IN SEVERAL SOLVENTS.

(v. Wartenberg and Podjaski, 1925.)

Solvent	t°	Bunsen Abs. Coef. β
Acetic acid	18.2	2.57
"	30.2	1.74
"	38.3	1.54
Acetic anhydride	0	2.08
Dichlor acetic acid	0	1.65
Propionic acid	17.3	3.73
Propionic anhydride	18.2	2.82
Carbon tetra chloride	0	3.04

*See p. 1352.

OSMIUM TETROXIDE OsO_4

SOLUBILITY OF OSMIUM TETROXIDE IN WATER.

The results of Squire and Caines, 1905; v. Wartenberg, 1924; Tschugajew and Fritmann, 1928 and Anderson and Yost, 1938, were plotted and the following values taken from the average curve.

t°	Gms. OsO_4 per 100 gms. sat. sol.
0	5.00
5	5.20
10	5.44
15	5.70
20	6.04
25	6.56

DISTRIBUTION OF OSMIUM TETROXIDE BETWEEN
WATER AND CARBON TETRACHLORIDE AT 25°.
(Anderson and Yost, 1938.)

Gm. Mol. OsO ₄ per 1.0 gm. mol.		g	Gm. Mol. OsO ₄ per 1.0 mol.		g
H ₂ O layer (w)	CCl ₄ layer (c)	w	H ₂ O layer (w)	CCl ₄ layer (c)	w
0.0001464	0.01204	82.2	0.00189	0.1563	82.7
0.000405	0.0320	79.0	0.00196	0.175	89.3
0.000582	0.0424	72.9	0.00234	0.22	94
0.000614	0.0424	81.2	0.002715	0.2564	94.5
0.000653	0.0530	81.2	0.00381	0.426	112.0
0.000715	0.0582	81.4	0.00423	0.520	123
0.00135	0.109	80.7	0.00459	0.6065	132.2
0.00137	0.117	85.4	0.00470	0.598	127.3
			0.00507	0.693	136.5

100 gms. H₂O dissolve 7.24 gms. OsO₄ at 25°.

100 gms. CCl₄ dissolve 375 ± 17 gms. OsO₄ at 25°.

The authors also give vapor pressure measurements of solution of OsO₄ in CCl₄ at 25°.

PHOSPHORUS P. (yellow)

SOLUBILITY IN BENZENE.

(Christomanos — Z. anorg. Ch. 45, 136, 195.)

t°.	Gms. P per 100 Gms. C ₆ H ₆ .	Sp. Gr. of Solution.	t°.	Gms. P per 100 Gms. C ₆ H ₆ .	Sp. Gr. of Solution.	t°.	Gms. P per 100 Gms. C ₆ H ₆ .
0	1.513	...	23	3.399	0.8875	50	6.80
5	1.99	...	25	3.70	0.8861	55	7.32
8	2.31	0.8990	30	4.60	...	60	7.90
10	2.4	0.8985	35	5.17	...	65	8.40
15	2.7	0.894	40	5.75	...	70	8.90
18	3.1	0.892	45	6.11	...	75	9.40
20	3.2	0.890				81	10.03

SOLUBILITY OF PHOSPHORUS IN ETHER.

(Christomanos.)

t°.	Gms. P per 100 Gms. (C ₂ H ₅) ₂ O.	Sp. Gr. of Solutions.	t°.	Gms. P per 100 Gms. (C ₂ H ₅) ₂ O.	Sp. Gr. of Solutions.	t°.	Gms. P per 100 Gms. (C ₂ H ₅) ₂ O.
0	0.434	...	15	0.90	0.723	28	1.60
5	0.62	...	18	1.01	0.719	30	1.75
8	0.79	0.732	20	1.04	0.718	33	1.80
10	0.85	0.729	23	1.12	0.722	35	2.00
			25	1.39	0.728		

SOLUBILITY OF YELLOW PHOSPHORUS IN SEVERAL SOLVENTS AT 15°.

(Stich, 1903.)

Solvent.	Gms. P per 100 Gms. Solution.
Almond Oil	1.25
Oleic Acid	1.06
Paraffin	1.45
Water	0.0003
Acetic Acid (96%)	0.105

100 gms. Phosphorus Tri Oxide (P₂O₃) dissolve 1.7 gm. P at 25°.
(Miller, 1928.)

SOLUBILITY OF PHOSPHORUS IN CARBON DISULFIDE.

(Cohn and Inouye, 1910.)

t°.	Gms. P per 100 Gms. Sat. Sol.	t°.	Gms. P per 100 Gms. Sat. Sol.	t°.	Gms. P per 100 Gms. Sat. Sol.
-10	31.40	-3.5	66.14	0	81.27
-7.5	35.85	-3.2	71.72	+5	86.3
-5	41.95	-2.5	75	10	89.8

The above determinations were made with very great care. The authors show that the previous determinations of Giran (1903) are inaccurate.

100 gms. alcohol ($d = 0.799$) dissolve 0.312 gm. P, cold, and 0.416 gm., hot. (Büchner)

100 gms. glycerol ($d_{15} = 1.256$) dissolve 0.25 gms. P at 15-16°. (Ossendowski, 1907.)

Red phosphorus is completely insoluble in turpentine even up to 270° provided the determination is made without access of air (sealed tube). If air is not excluded a portion of the red phosphorus may be converted to yellow phosphorus which would dissolve. (Colson, 1907.)

 RECIPROCAL SOLUBILITY OF PHOSPHORUS AND SULFUR, DETERMINED BY
 THE SYNTHETIC (Sealed Tube) METHOD.

(Giran, 1906.)

(Mixtures of P and S were sealed in small tubes and first heated to about 200° to cause combination. They were then cooled to the solidification point and gradually heated to the temperature at which the last crystal disappeared. The following results, which were read from the diagram, show the eutectics and maxima of the curves.)

Eutectics.			Maxima of Curves.		
t°.	Mols. % S in Mixture.	Solid Phase.	t°.	Mols. % S in Mixture.	Solid Phase.
-40	33.5	P ₄ S ₃ +P ₄	+167	43.6	P ₄ S ₃
+46	50	P ₄ S ₃ +P ₄ S ₂	296	60.8	P ₄ S ₂
230	67.5	P ₄ S ₂ +P ₄ S ₄	272	72.1	P ₄ S ₄
243	75	P ₄ S ₂ +P ₄ S ₆	314	86.1	P ₄ S ₆

Additional data for this system are given by Boulouch (1902 and 1906) and by Helff, 1893.

Fusion-point data for mixtures of Phosphorus and Selenium are given by Robinson and Scott, 1933. Results for mixtures of Phosphorus and Thallium are given by Mansuri, 1927.

PHOSPHORUS BROMIDE PBr₃.

Fusion-point data are given for:

PBr ₃ + S ₂ Br ₂	(Pusin and Makuc, 1938.)
" + SnBr ₄	" " "
" + SbBr ₃	" " "
" + PSBr ₃	(Van Arkel and Lebbink, 1937.)

PHOSPHORUS CHLORIDE PCl₃.

Fusion-point data are given for:

PCl ₃ + SnCl ₄	(Pusin and Makuc, 1938.)
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PHOSPHORUS IODIDE PI₃.

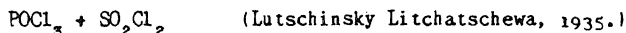
Fusion-point data are given for:

PI ₃ + SbI ₃	(Jaeger and Doornbosch, 1912.)
------------------------------------	--------------------------------

P PHOSPHORUS 1364

PHOSPHORUS Oxy CHLORIDE POCl_3 .

Fusion-point data are given for:



PHOSPHORUS SULFIDES P_4S_3 , P_4S_7 , P_4S_{10} .

SOLUBILITY IN CARBON DISULFIDE, BENZENE, AND IN TOLUENE.
(Stock, 1910.)

t°.	Gms. P_4S_3 per 100 Gms.:			Gms. P_4S_7 per 100 Gms. CS_2 .	Gms. P_4S_{10} per 100 Gms. CS_2 .
	CS_2 .	C_6H_6 .	$\text{C}_6\text{H}_5\text{CH}_3$.		
S -20	11.1	...	...	...	0.083
0	27	...	...	0.005	0.182
+17	100	2.5	3.125	0.0286	0.223
80	...	11.1	...	...	...
110	...	...	15.4	...	...

PHOSPHORUS SELENIDE P_4Se_3 .

100 cc carbon disulfide dissolve 7.1 gm. P_4Se_3 at about 20°.
(Mai, 1928.)

Se

PHOSPHO MOLYBDIC ACID $\text{P}_2\text{O}_5 \cdot 20\text{MoO}_3 \cdot 52\text{H}_2\text{O}$.

SOLUBILITY IN ETHER. (Parmentier, 1887.)

t°.	0°.	8.1°.	19.3°.	27.4°.	32.9°.
Gms. Acid per 100 gms. Ether	80.6	84.7	96.7	103.9	107.9

LEAD Pb.

An extensive investigation of the solubility of lead in the water passing through lead pipes is described by Paul, Ohlmüller, Heise and Auerbach, 1906. The solubility is increased by oxygen, CO_2 , sulfates and perhaps other salts; it is decreased by hydrocarbonates.

More recent experiments upon this subject are described by Zink, 1933. Lead of 98.24 percent purity was subjected to the action water free from and containing CO_2 and various salts for periods of 24 hours. The bearing of these results upon the use of lead pipes as conductors for water supplies is discussed. Since the constituents of water passing through lead pipes form compounds which coat the interior of the pipes, the author gives the following values for the solubility of some of these products.

Compound	Hgs. Pb dissolved per liter
Lead Oxide PbO	63.8
Lead Hydroxide $3\text{PbO} \cdot \text{H}_2\text{O}$	93.3
Lead Carbonate (observed)	1.75
" " (calculated)	0.04
$\frac{1}{2}$ basic " (observed)	1.3
$\text{PbO} \cdot 2\text{PbCO}_3 \cdot \text{H}_2\text{O}$ (calculated)	less than 0.04
Lead Sulfate PbSO_4	26.0
$\frac{1}{2}$ basic " $\text{PbO} \cdot \text{PbSO}_4$	10.6
$\frac{1}{2}$ " " $3\text{PbO} \cdot \text{PbSO}_4 \cdot \text{H}_2\text{O}$	22.0
Lead Chloride PbCl_2	696.0
$\frac{1}{2}$ basic " $\text{PbO} \cdot \text{PbCl}_2 \cdot \text{H}_2\text{O}$	79.0
$\frac{1}{2}$ " " $3\text{PbO} \cdot \text{PbCl}_2 \cdot \text{H}_2\text{O}$	21.0
Lead Nitrate $\text{Pb}(\text{NO}_3)_2$	516.0

SOLUBILITY OF LEAD IN LIQUID AMMONIA-SODIUM SOLUTIONS AT -33° .
(Smith, F. H., 1917.)

Gm. Atoms Sodium per Liter of Liquid Ammonia.	Gm. Atoms Pb Dissolved per Gm. Atom Na.	Gm. Atoms Na per Liter of Liquid Ammonia.	Gm. Atoms Pb Dissolved per Gm. Atom Na.
0.078	1.95	0.13	2.17
0.093	2.20	0.14	2.12
0.094	2.03	0.33	1.83
0.110	2.24	0.34	1.73
0.12	1.78		

SOLUBILITY OF LEAD IN MERCURY.

(Thompson, 1935.)

A special apparatus and technique was necessary to avoid the oxidation which rapidly occurs in lead amalgams.

t°	Gm. Atom Percent Pb in sat. sol.	t°	Gm. Atom Percent Pb in sat. sol.
20	1.476	50	2.742
30	1.780	60	3.419
40	2.199	70	4.330

AsO

LEAD ARSENATE.

SOLUBILITY OF COMMERCIAL LEAD ARSENATE IN AQUEOUS SOLUTIONS OF SALTS.
(Stewart, 1922.)

The sample of commercial lead arsenate was guaranteed to contain not less than 25 per cent of arsenic and not more than $1\frac{1}{2}$ per cent water soluble arsenic. The aqueous solutions containing an excess of the lead arsenate were shaken two or more times daily for three weeks or more at room temperature. One liter of each sat. solution was treated with 10 cc. of HNO_3 + 10 cc. of H_2SO_4 and evaporated to appearance of white fumes. The arsenic in the residue was determined by the modified Williamson method. Two concentrations of salt solutions were used, namely 0.01447 normal and 0.0723 normal. The solubility of the lead arsenate in distilled water was found to be 3.0 parts arsenic per million. In tap-water containing 212 parts of solids per million (mostly Ca and Mg bicarbonates) it was 33.8 parts arsenic per million.

RESULTS FOR THE SOLUBILITY OF LEAD ARSENATE IN 0.01447
NORMAL SALT SOLUTIONS.

Parts Arsenic dissolved per million parts of aqueous solution of

Salt of.	Carbonate.	Chloride.	Nitrate.	Bicarbonate.	Sulfate.	Bisulfate.	Secondary Phosphate.	Primary Phosphate.
K.....	165.2	39.3	4.5	139.9	4.6	241.9	174.2	29.1
Na.....	184.8	31.7	5.3	136.4	5.9	260.9	168.9	11.8
NH_4	175.6	37.0	3.4	136.4	3.5	271.5	177.6	18.7
Ca.....	73.4	54.7	2.0	—	5.6	296.3	73.9	36.6
Mg.....	4.1	36.6	3.5	37.4	4.5	268.5	93.5	21.0

SOLUBILITY OF COMMERCIAL LEAD ARSENATE IN AQUEOUS SOLUTIONS OF SALTS.

(Stewart, 1922.)

Results for the solubility in 0.0723 normal salt solutions.

Parts Arsenic dissolved per million parts of aqueous solution of

Salt of :	Carbonate.	Chloride.	Nitrate.	Bicarbonate.	Sulfate.	Disulfate.	Secondary Phosphate.	Primary Phosphate.
K.....	115.9	156.0	8.1	99.8	5.8	647.2	292.9	78.0
Na.....	131.8	130.5	13.5	96.7	5.7	1016.9	357.0	84.6
NH ₄	119.2	—	5.4	162.5	—	838.3	392.1	63.0
Ca.....	36.5	105.4	4.3	13.5	4.2	615.2	57.7	67.5
Mg.....	20.1	101.2	3.5	85.4	2.6	572.3	46.1	38.0

Each result in the tables represent an average of 2 to 10 determinations.

Data are also given for the solubility of lead arsenate in soil solutions.

Data for equilibrium in the system lead oxide, arsenic trioxide and water at 25° are given by Story and Anderson, 1924.

Fusion point data for the systems $Pb_3(AsO_4)_2 + PbF_2$, $Pb_3(AsO_4)_2 + PbCl_2$ and $Pb_3(AsO_4)_2 + PbO$ are given by Amadori, 1916-1917, 1919.

The solubility of commercial lead hydrogen arsenate, containing 64.2% PbO and 32.54% As_2O_3 , in aqueous solutions of acids and salts and their combinations was studied by Robinson, 1929, for the purpose of finding the best solvent for use in removing arsenical spray residues from fruit under commercial conditions. It was found that acids dissolve the maximum amount of arsenate in 5 minutes with no increase up to 30 minutes. Most of the dilute salt solutions dissolved only a trace of the arsenical. When 0.25 percent Na_2SO_4 was combined with 0.1 percent HCl the solubility was increased to more than 5 times that for HCl alone. This combination was found to be the most effective.

LEAD ARSENATE $PbHAsO_4$.

Two gm. portions of amorphous dilead arsenate were agitated at 32° with 90 to 180 cc. portions of 0.0338 normal aqueous ammonia for two days. The saturated solutions were found to contain only traces of lead but amounts of As_2O_6 varying from 1.956 to 1.429 gms. per liter.

(McDonnell and Smith, 1916.)

EQUILIBRIUM IN THE SYSTEM LEAD OXIDE, ARSENIC**PENTOXIDE AND WATER AT 25° (Acid Region)**

(Tartar, Rice and Sweo, 1931.)

d. of sat. sol.	Gms. As_2O_5 per 100 gms. sat. sol.	Solid Phase	d. of sat. sol.	Gms. As_2O_5 per 100 gms. sat. sol.	Solid Phase
1.031	2.10	$PbHAsO_4$	1.732	54.56	$PbHAsO_4$
1.113	13.40	" "	1.894	61.35	" + $Pb(H_2AsO_4)_2$
1.219	23.50	" "	2.032	65.90	$Pb(H_2AsO_4)_2$
1.476	42.61	" "	2.201	70.70	" "
1.232	54.56	" "	—	71.4	" + $H_3AsO_4 \cdot \frac{1}{2}H_2O$

The results show that the lead arsenates are very insoluble.

Qualitative tests of the liquid phase for the precipitation of lead as sulfate, chromate and sulfide gave negative results. It is suggested that precipitation as dilead arsenate can be used as a quantitative method for the determination of lead.

LEAD BORATE $Pb(BO_2)_2 \cdot H_2O$.100 cc. anhydrous hydrazine dissolve about 2 gms. $Pb(BO_2)_2$ at room temp.

(Welsh and Broderson, 1915.)

LEAD Sub BROMIDE $PbBr$.

1000 cc. sat. solution of lead subbromide in water contain 0.4 milliequivalents Pb Br at 25°, as determined by the conductivity method.

(Denham, 1918.)

LEAD BROMIDE PbBr_2 .**SOLUBILITY IN WATER.**

(Lichty — J. Am. Chem. Soc. 25, 474, '03.)

t°.	Density of Solutions, H_2O at 0°.	Gms. PbBr_2 per 100		Milligram Mols. PbBr_2 per 100	
		cc. Solution.	Gms. H_2O .	cc. Solution.	Gms. H_2O .
0	1.0043	0.4554	0.4554	1.242	1.242
15	1.0053	0.7285	0.7305	1.987	1.989
25	1.0061	0.9701	0.9744	2.646	2.655
35	1.0060	1.3124	1.3220	3.577	3.603
45	1.0059	1.7259	1.7457	4.705	4.760
55	1.0046	2.1024	2.1376	5.731	5.827
65	1.0028	2.516	2.574	6.859	7.016
80	1.0000	3.235	3.343	8.819	9.113
95	0.9995	4.1767	4.3613	11.386	11.890
100	...	4.550	4.751	12.40	12.94

SOLUBILITY OF LEAD BROMIDE IN WATER AT TEMPERATURES ABOVE 100°.

(Benrath, Ojedebo, Schiffers and Wunderlich, 1937.)

t°	Gms. PbBr_2 per 100 gms. sat. sol.	t°	Gms. PbBr_2 per 100 gms. sat. sol.
143	7.3	285	33.5
181	12.0	302	46.7
217	17.1	302	57.5
245	22.4	302	71.0
26.7	28.2	307	86.6

Between 39 and 80 percent PbBr_2 two liquid layers are formed at 302°.**SOLUBILITY OF LEAD BROMIDE IN AQUEOUS HYDROBROMIC ACID
AT 10°.**100 grams H_2O containing 72.0 grams HBr dissolve 55.0 grams PbBr_2 per 100 gms. solvent, and solution has Sp. Gr. 2.06.

(Ditte — Compt. rend 92, 719, '81.)

**SOLUBILITY OF LEAD BROMIDE IN AQUEOUS SOLUTIONS OF
HYDROBROMIC ACID AT 25°.**

(v. Hevesy and Wagner, 1930.)

d. of sat. sol.	Normality of aq. HBr solution	Gms. PbBr_2 per 100 cc sat. sol.
1.005	0.0	0.9711
1.0074	0.014	0.946
1.056	1.065	0.390
1.099	1.721	0.980
1.443	4.200	24.540

LEAD BROMIDE PbBr_2 .

SOLUBILITY OF LEAD BROMIDE IN AQUEOUS SOLUTIONS OF SALTS AT 25°.

(Herz and Hellebrandt, 1923.)

Aq. salt solution.	Gm. mol. PbBr_2 per liter sat. sol.	Aq. salt solution.	Gm. mol. PbBr_2 per liter sat. sol.	Aq. salt solution.	Gm. mol. PbBr_2 per liter sat. sol.
H_2O alone	0.02625	0.73 n Na Br	0.00860	2.95 n $\frac{\text{Ca Cl}_2}{2}$	0.01357
0.48 n KCl	0.00556	1.47 »	0.02247	3.93 »	0.02355
0.97 »	0.00582	2.20 »	0.07043	0.52 n $\frac{\text{Ca Br}_2}{2}$	0.00677
1.94 »	0.00620	2.93 »	0.1958	1.04 »	0.01205
2.91 »	0.01057	3.67 »	0.3936	2.08 »	0.04380
3.88 »	0.01505	4.40 »	0.7337	3.13 »	0.1175
0.79 n KBr	0.00725	0.52 n $\frac{\text{Ba Cl}_2}{2}$	0.00574	4.17 »	0.5187
1.58 »	0.00874	1.04 »	0.00765	0.66 n $\frac{\text{Sr Cl}_2}{2}$	0.00564
2.16 »	0.02650	2.08 »	0.02388	1.23 »	0.00627
3.23 »	0.08542	0.45 n $\frac{\text{Ba Br}_2}{2}$	0.00607	2.66 »	0.01545
4.28 »	0.17900	0.91 »	0.01091	3.09 »	0.02000
0.47 n NaCl	0.00456	1.82 »	0.04443	4.18 »	0.02718
0.95 »	0.00561	2.76 »	0.1604	0.52 n $\frac{\text{Sr Br}_2}{2}$	0.00673
1.89 »	0.00844	3.67 »	0.4140	1.04 »	0.01273
2.84 »	0.01466	0.49 n $\frac{\text{Ca Cl}_2}{2}$	0.00462	2.08 »	0.04367
3.79 »	0.03053	0.98 »	0.00544	3.12 »	0.1559
4.74 »	0.06144	1.97 »	0.00693	4.16 »	0.5687

Br

SOLUBILITY OF LEAD BROMIDE IN AQUEOUS SALT SOLUTIONS AT 25°.

(Randall and Vietti, 1928.)

In Aqueous Solutions of:

Lead Nitrate

Barium Nitrate

Cadmium Bromide

Potassium Nitrate

Gm. Mols. per 1000 gms. H_2O		Gm. Mols. per 1000 gms. H_2O		Gm. Mols. per 1000 gms. H_2O		Gm. Mols. per 1000 gms. H_2O	
$\text{Pb}(\text{NO}_3)_2$	PbBr_2	$\text{Ba}(\text{NO}_3)_2$	PbBr_2	CdBr_2	PbBr_2	KBr	PbBr_2
0.002	0.02664	0.000	0.02680	0.0010	0.02637	0.001	0.02645
0.005	0.02644	0.002	0.02735	0.0020	0.02591	0.002	0.02611
0.010	0.02622	0.005	0.02808	0.0050	0.02466	0.005	0.02500
0.050	0.02663	0.010	0.02883	0.0100	0.02307	0.010	0.02345
0.100	0.02954	0.020	0.03034	0.0500	0.01450	0.050	0.01380
0.200	0.03544	0.050	0.03370	0.1000	0.01117	0.100	0.00859
0.500	0.05342	0.100	0.03780	0.2000	0.00939	0.200	0.00694
0.952	0.07754	0.200	0.04385	0.5000	0.01072	0.389	0.00700**
1.655	0.1268	0.3513	0.05008	1.000	0.01597	0.804	0.00740**
1.964	0.1346*	0.4116	0.05337*	4.182	0.06508*	1.200	0.01137**

* These solutions simultaneously saturated with both salts.

**Solid phase $2\text{PbBr}_2 \cdot \text{KBr}$.

**SOLUBILITY OF LEAD BROMIDE IN AQUEOUS SOLUTIONS OF POTASSIUM BROMIDE
AT 25° AND VICE VERSA. (Burrage, 1926.)**

Gms. per 1000 gms. sat. sol.		Solid Phase.	Gms. per 1000 gms. sat. sol.		Solid Phase.
K Br.	Pb Br ₂ .		K Br.	Pb Br ₂ .	
0.0	9.69	Pb Br ₂	190.5	6.66	KBr. 2 Pb Br ₂
0.56	9.46	"	206.4	7.53	"
1.31	8.75	"	216.1	8.68	"
4.23	7.82	"	256.9	14.94	"
13.25	3.47	"	301.1	31.60	" + KBr. Pb Br ₂ . 1/3 H ₂ O
22.92	2.56	"	319.7	36.22	KBr. Pb Br ₂ . 1/3 H ₂ O
49.67	3.10	" + KBr. 2 Pb Br ₂	338.0	42.48	"
56.09	2.92	K Br. 2 Pb Br ₂	356.8	50.38	"
129.4	3.30	"	388.7	72.05	" + K Br
131.8	3.45	"	393.2	49.29	K Br
145.4	4.27	"	402.8	18.35	"
182.7	5.60	"	405.2	0.0	"

Data for the solubility of mixed crystals of lead bromide and lead chloride in water are given by Meyer, 1922, 1926.

**SOLUBILITY OF LEAD BROMIDE IN PYRIDINE.
(Heise, 1912.)**

t°.	Gms. Pb Br ₂ per 100 Gms. Pyridine.	Solid Phase.	t°.	Gms. Pb Br ₂ per 100 Gms. Pyridine.	Solid Phase.
-26	1.02	Pb Br ₂ · 3 C ₅ H ₅ N	45	0.661	Pb Br ₂ · 2 C ₅ H ₅ N
-10	0.89	"	64	0.800	"
-5	0.84	"	77	0.969	"
0	0.80	"	95	1.33	"
+13	0.661	"	100	1.44	"
19 tr. pt.	...	" + Pb Br ₂ · 2 C ₅ H ₅ N	105	1.56	"
26	0.583	Pb Br ₂ · 2 C ₅ H ₅ N			

100 gms. liquid Sulfur Dioxide (SO₂) dissolve 0.012 gm. Pb Br₂ at 0°.
(Jander and Ruppolt, 1937.)

Fusion-point data are given for:

Pb Br ₂ + Ag Br	(Tubaudt and Eggert, 1920.)
" + Pb Cl ₂	(Monkemeyer, 1906.)
" + Pb F ₂	(Sandonnini, 1911.)
" + Pb I ₂	(Monkemeyer, 1906.)
" + Pb O ₂	(Sandonnini, 1914; Baroni, 1934.)

LEAD Dicyclohexyl Di**BROMIDE** (C₆H₁₁)₂Pb Br₂.

LEAD Dicyclohexyl Di**CHLORIDE** (C₆H₁₁)₂Pb Cl₂.

**SOLUBILITY OF EACH IN SEVERAL SOLVENTS AT 22.5°.
(Grüttner, 1914.)**

Solvent.	Grams per 100 Grams Solvent.	
	(C ₆ H ₁₁) ₂ Pb Br ₂ .	(C ₆ H ₁₁) ₂ Pb Cl ₂ .
Benzene	0.014	0.016
Carbon Tetrachloride	0.004	0.004
Chloroform	0.078	0.083
Alcohol + Pyridine (1:1)	2.560	2.904

Similar results are also given for lead tetracyclohexyl, Pb(C₆H₁₁)₄, lead tetraphenyl, Pb(C₆H₅)₄, and lead diphenyldicyclohexyl, Pb(C₆H₅)₂(C₆H₁₁)₂.

Solvent.	Gms. per 100 Gms. Solvent.		
	Pb(C ₆ H ₁₁) ₄ .	Pb(C ₆ H ₅) ₄ .	Pb(C ₆ H ₅) ₂ (C ₆ H ₁₁) ₂ .
Alcohol	0.010	0.020	0.324
Benzene	1.068	1.145	2.208
Carbon Tetrachloride	0.244	0.303	0.845
Ethyl Acetate	0.030	0.123	0.231

Pb PLUMBUM

1370

LEAD BROMATE $\text{Pb}(\text{BrO}_3)_2$.

SOLUBILITY OF LEAD BROMATE IN AQUEOUS SALT SOLUTIONS AT 25° .
(MacDougall and Hoffman, 1936.)

Results for Aqueous Solutions of:

Potassium Nitrate

d. of sat. sol.	Gm. Mols. per liter sat. sol.	
	KNO_3	$\text{Pb}(\text{BrO}_3)_2$
1.0112	0.0	0.03437
1.0156	0.04883	0.03924
1.0181	0.09934	0.04378
1.0286	0.1956	0.05104
1.0456	0.3901	0.06396
1.0608	0.5784	0.07577
1.0906	0.9339	0.09818
1.1327	1.4419	0.1293
1.1833	2.0352	0.1685
1.2220	2.6423	0.1732

Sodium Nitrate

d. of sat. sol.	Gm. Mols. per liter sat. sol.	
	NaNO_3	$\text{Pb}(\text{BrO}_3)_2$
1.0141	0.04833	0.03884
1.0184	0.1013	0.04317
1.0266	0.1991	0.04984
1.0424	0.3938	0.06144
1.0564	0.5874	0.07112
1.0837	0.9655	0.08898
1.1460	1.8655	0.1294
1.2010	2.6860	0.1651
1.3378	4.8546	0.2536
1.4824	7.1770	0.3416

Lithium Nitrate

d. of sat. sol.	Gm. Mols. per liter sat. sol.	
	LiNO_3	$\text{Pb}(\text{BrO}_3)_2$
1.0135	0.04925	0.03849
1.0158	0.09873	0.04224
1.0244	0.2049	0.04874
1.0348	0.3633	0.04800
1.0446	0.5815	0.06517
1.0649	0.9644	0.07867
1.0880	1.4258	0.09337
1.1302	2.3032	0.1190
1.1887	3.5192	0.1534
1.2562	4.9703	0.1930

Strontium Nitrate

d. of sat. sol.	Gm. Mols. per liter sat. sol.	
	$\text{Sr}(\text{NO}_3)_2$	$\text{Pb}(\text{BrO}_3)_2$
1.0117	0.00557	0.03581
1.0129	0.01031	0.03702
1.0144	0.01958	0.03893
1.0226	0.05020	0.04455
1.0332	0.09944	0.05180
1.0548	0.1975	0.06339
1.0933	0.3903	0.08177
1.1301	0.5804	0.09739
1.1971	0.9446	0.1249
1.3438	1.7789	0.1765
1.5261	2.8704	0.2228

Calcium Nitrate

d. of sat. sol.	Gm. Mols. per liter sat. sol.	
	$\text{Ca}(\text{NO}_3)_2$	$\text{Pb}(\text{BrO}_3)_2$
1.0099	0.00627	0.03565
1.0117	0.01116	0.03640
1.0135	0.02156	0.03921
1.0195	0.05162	0.04298
1.0313	0.1215	0.05387
1.0425	0.1975	0.06202
1.0869	0.4920	0.08769
1.1283	0.7784	0.1105
1.2090	1.3805	0.1435
1.3074	2.1719	0.1813
1.4215	3.1950	0.2118

Lead Nitrate

d. of sat. sol.	Gm. Mols. per liter sat. sol.	
	$\text{Pb}(\text{NO}_3)_2$	$\text{Pb}(\text{BrO}_3)_2$
1.0104	0.00495	0.03371
1.0118	0.00992	0.03312
1.0132	0.01990	0.03258
1.0219	0.04981	0.03161
1.0356	0.0994	0.03145
1.0643	0.1978	0.03264
1.1120	0.3882	0.03657
1.1735	0.5804	0.04102
1.2786	0.9470	0.05046
1.3402	1.1663	0.05613
1.4011	1.3807	0.06183

LEAD FORMATE $\text{Pb}(\text{HCOO})_2$.

SOLUBILITY OF LEAD FORMATE IN AQUEOUS SOLUTIONS OF BARIUM FORMATE AT 25°.
(Fock, 1897.)

Mol. % in Solution.		Grams per Liter.		Sp. Gr. of Solutions.	In Solid Phase		Mol. % of
$\text{Pb}(\text{HCOO})_2$.	$\text{Ba}(\text{HCOO})_2$.	$\text{Pb}(\text{HCOO})_2$.	$\text{Ba}(\text{HCOO})_2$.		$\text{Pb}(\text{HCOO})_2$.	$\text{Ba}(\text{HCOO})_2$.	
0	100	...	28.54	1.2204	0	100	
0.29	99.71	1.104	28.65	1.2213	1.72	98.28	
0.74	99.26	2.803	28.90	1.2251	5.29	94.71	
1.24	98.76	5.309	32.24	1.2529	11.94	88.06	
2.91	97.09	11.42	29.29	1.2341	24.81	75.19	
5.92	94.08	23.11	28.13	1.2355	56.54	43.46	
100	0	28.35	...	1.0911	100	0	

SOLUBILITY OF LEAD FORMATE IN FORMIC ACID DETERMINED
BY THE FREEZING-POINT METHOD.
(Kendall and Adler, 1921.)

t°	Gm. Mol. $\text{Pb}(\text{HCOO})_2$ per 100 gm. mol. sat. sol.	Solid Phase
20	0.21	$\text{Pb}(\text{HCOO})_2$
73.1	0.30	"
109.4	0.42	"
124.5	0.51	"

LEAD METHIONATE $\text{Pb} \text{CH}_2\text{O}_6\text{S}_2 \cdot 2\text{H}_2\text{O}$.

100 gms. H_2O dissolve 8.4 gm. $\text{PbCH}_2\text{O}_6\text{S}_2$ at 25°. (Backer and Terpstra, 1929.)

CH

LEAD ACETATE $\text{Pb}(\text{CH}_3\text{COO})_2 \cdot 3\text{H}_2\text{O}$.

SOLUBILITY OF LEAD ACETATE IN WATER. (Dundon and Henderson, 1922.)

The analysis of the saturated solutions was made by a method of « floating equilibrium ». To a known weight of saturated solution of unknown concentration, water was added until the mixture attained the same density as a glass float calibrated at a definite arbitrary temperature. The saturated solutions were prepared by constant stirring in a thermostat and approaching equilibrium from 0.5 to 3.0 above the temperature desired. The solid was $\text{Pb}(\text{CH}_3\text{COO})_2 \cdot 3\text{H}_2\text{O}$ in all cases.

t°.	d of sat. sol.	Gms. $\text{Pb}(\text{CH}_3\text{COO})_2$ per 100 gms.		t°.	d of sat. sol.	Gms. $\text{Pb}(\text{CH}_3\text{COO})_2$ per 100 gms.	
		H_2O .	sat. sol.			H_2O .	sat. sol.
0...	1.140	19.7	16.5	30 ..	1.41	69.7	41.1
5...	—	23.6	19.4	35...	1.48	88.9	47.1
10...	1.195	29.3	22.8	40...	1.60	116.0	53.7
15...	1.220	35.6	26.4	45...	1.73	153.0	60.7
20...	1.260	44.3	30.7	50...	1.88	221.0	67.6
25...	1.330	55.2	35.6				

SOLUBILITY OF LEAD ACETATE IN AQUEOUS SOLUTIONS OF ACETIC ACID.
(Osaka and Hara, 1917.)

The saturated solutions were prepared by constant agitation for two days. The lead in the saturated solutions was determined as sulfate.

Normality of Aq. CH_3COOH .	Gms. $\text{Pb}(\text{CH}_3\text{COO})_2$ per 100 gms. sat. sol. at		
	25°.	35°.	45°.
0.025.....	35.11	46.65	60.61
0.05.....	34.96	46.56	60.55
0.10.....	34.72	46.35	60.42

LEAD ACETATE

EQUILIBRIUM IN THE SYSTEM LEAD ACETATE, ACETIC ACID AND WATER AT 25°.
(Tarbutton and Vosburgh, 1932.)

From 7 to 14 days were required for attainment of equilibrium depending upon the manner of preparing the solutions. The previous results of Sandved, 1927, are shown to be in error in certain respects.

Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase
CH ₃ COOH	Pb(CH ₃ COO) ₂		CH ₃ COOH	Pb(CH ₃ COO) ₂	
0.00	35.50 (1)	Pb(CH ₃ COO) ₂ ·3H ₂ O	24.13	68.33	Pb(CH ₃ COO) ₂ ·½H ₂ O
8.21	35.44	"	25.50	70.54	"
19.14	39.13	"	25.20	71.54	"
26.91	47.11	"	30.94	66.00	Pb(CH ₃ COO) ₂ ·½CH ₃ COOH
26.55	57.38	"	31.71	65.66	"
22.27	67.90	" + Pb(CH ₃ COO) ₂ ·½H ₂ O	40.19	58.29	"
			41.82	57.06	"
23.25	68.15	Pb(CH ₃ COO) ₂ ·½H ₂ O	44.56	54.95	"

(1) Jackson, 1914.

The authors also give the following results at 30°.

CH

Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase
CH ₃ COOH	Pb(CH ₃ COO) ₂		CH ₃ COOH	Pb(CH ₃ COO) ₂	
9.64	41.61	Pb(CH ₃ COO) ₂ ·3H ₂ O	25.40	69.45	Pb(CH ₃ COO) ₂ ·½H ₂ O
17.47	45.81	"	20.49	69.27	"
23.78	55.43	"	24.36	73.50	"
22.45	63.08	"	23.66	72.13	"
23.86	71.08	"	19.92	70.18	"
			23.39	70.45	"

LEAD ACETATE Pb(C₂H₃O₂)₂·3H₂O.

EQUILIBRIUM IN THE SYSTEM LEAD OXIDE, ACETIC ACID, WATER AT 25°.
(Sakabe, 1914.)

Gms. per 100	Gms. Sat. Sol.	Solid Phase.	Gms. per 100	Gms. Sat. Sol.	Solid Phase.
PbO.	CH ₃ COOH.		PbO.	CH ₃ COOH.	
4.18	21.53	Pb(C ₂ H ₃ O ₂) ₂ ·3H ₂ O			
3.80	16.78	"	7.15	7.26	(C ₂ H ₃ O ₂) ₂ (HO)Pb + (C ₂ H ₃ O ₂) ₂ Pb ₂ (HO) ₂ Pb
3.16	13.07	"	5.20	5.61	(C ₂ H ₃ O ₂) ₂ Pb ₂ (HO) ₂ Pb
2.64	5.49	"	3.78	4.17	"
3.34	5.36	"	2.89	2.51	"
4.38	7.30	"	1.45	1.03	"
5.18	7.92	" + (C ₂ H ₃ O ₂) ₂ (HO)Pb	1.05	0.54	PbO
5.59	7.72	(C ₂ H ₃ O ₂) ₂ (HO)Pb	1.07	0.48	"
6.51	7.79	"	1	0.20	"

Equilibrium was attained quickly in the acid solutions but 2-3 days were required in case of the basic salts. Both sat. solutions and solid phases were analyzed.

EQUILIBRIUM IN THE SYSTEM LEAD ACETATE, LEAD OXIDE, WATER AT 25°.
(Jackson, 1914.)

d_{25} of Sat. Sol.	Gms. per 100 PbO.	Gms. Sat. Sol. Pb(C ₂ H ₃ O ₂) ₂ .	Solid Phase.	d_{25} of Sat. Sol.	Gms. per 100 PbO.	Gms. Sat. Sol. Pb(C ₂ H ₃ O ₂) ₂ .	Solid Phase.
1.326	—0.27*	35.19	1.3	2.280	24.74	49.21	3.1.3 + 1.2.4
1.334	+0.10	35.60	"	2.048	23.59	43.17	1.2.4
1.367	1.01	37.14	"	1.951	22.78	40.78	"
1.422	3.38	38.93	"	1.657	19.63	31.40	"
1.531	6.01	41.95	"	1.599	18.73	29.63	"
1.658	9.47	44.71	"	1.382	14.62	20.96	"
...	14.22	47.88	"	1.348	13.41	19.65	"
1.852	14.44	47.92	"	1.229	10.66	12.99	"
...	15.89	48.95	1.3 + 3.1.3	1.157	8.47	8.64	"
1.930	15.90	48.42	3.1.3	1.119	7.87	5.27	"
1.942	16.25	48.85	"	1.117	7.79	5.25	"
1.956	16.65	49.04	"	...	7.17	4.17	Pb(OH) ₂
2.024	18.83	48.71	"	1.100	6.84	4.31	"
2.161	22.23	48.52	"	1.095	6.54	4.25	"
2.193	22.94	48.96	"	1.085	5.91	3.82	"
...	23.28	49.14	"	1.075	5.29	3.40	"
2.220	23.53	49.01	"	...	0.20	0.11	"

* In this case the acidity is expressed in terms of PbO.

1.3 = Pb(C₂H₃O₂)₂·3H₂O, 3.1.3 = 3Pb(C₂H₃O₂)₂·PbO·3H₂O, 1.2.4 = Pb(C₂H₃O₂)₂·2PbO·4H₂O.

The above results show the solubility of lead acetate in aqueous solutions containing increasing amounts of lead hydroxide. The mixtures were constantly agitated for periods varying from 2 to 7 days. Both the saturated solutions and the solid phases were analyzed. The basic lead in a given sample was determined by measuring the volume of standard acid neutralized by it. The neutral lead acetate was determined by precipitation of the lead as sulfate or as oxalate.

SOLUBILITY OF LEAD ACETATE IN AQ. SOLUTIONS OF POTASSIUM ACETATE AT 25°.
(Fox, 1909.)

Gms. per 100 CH ₃ COOK.	Gms. Sat. Sol. (CH ₃ COO) ₂ Pb.	Solid Phase.
0	35.9	(CH ₃ COO) ₂ Pb·3H ₂ O
13.87	38.05	"
15.40	36.90	"

Experiments on the formation of basic lead acetates in aqueous ammonium hydroxide and sodium hydroxide solutions are described by Dubrisay and Saint Maxen, 1936. The temperature or method of securing saturation is not stated. The results are given only in the form of a diagram which shows that in each case the amount of lead in solution increases from about 20 to 34 percent as the concentration of alkali increases from 0 to 0.04 gm. mol. percent (?) and then very rapidly decreases as the concentrations of alkali increases to about 0.1 gm. mol. percent.

Pb PLUMBUM
LEAD ACETATE

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EQUILIBRIUM IN THE SYSTEM LEAD ACETATE, LEAD CHLORIDE AND WATER AT 25°. (Sandved, 1929.)

The mixtures were prepared at 35° and after cooling to 25° equilibrium was attained in 5 hours. The concentration of free acid in the solutions varied from 1.4 to 1.6 percent. The system is therefore strictly speaking not ternary but "pseudo ternary".

Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase
PbCl ₂	Pb(CH ₃ COO) ₂		PbCl ₂	Pb(CH ₃ COO) ₂	
0.0	35.53	Pb(CH ₃ COO) ₂ ·3H ₂ O	3.32	25.95	D.S
0.73	35.92	"	4.48	21.25	" + PbCl ₂
1.08	36.40	"	4.00	20.63	PbCl ₂
1.46	37.43	" + D.S	3.01	13.47	"
2.03	36.44	D.S	2.07	6.91	"
2.43	30.21	"	1.06	0.0	"

D.S. = PbCl·CH₃COO·Pb(CH₃COO)₂·½CH₃COOH.

The author also gives similar results for the temperature 35° as well as complete results for the quarternary system Pb(CH₃COO)₂ + PbCl₂ + CH₃COOH + H₂O at 25°.

CH SOLUBILITY OF LEAD ACETATE IN ACETIC ACID DETERMINED.
BY THE FREEZING-POINT METHOD.

(Davidson and Chappell, 1933; Davidson and McAllister, 1930.)

t°	Gm. mol. Pb(CH ₃ COO) ₂ per 100 gm. mols. sat. sol.	Solid Phase	t°	Gm. mol. Pb(CH ₃ COO) ₂ per 100 gm. mols. sat. sol.	Solid Phase
16.5	0.0	CH ₃ COOH	40.5	24.77	Pb.½H
15.52	5.18	"	48.7	30.23	"
14.24	8.42	"	52.9	33.55	"
13.40	11.53	" + Pb.½H	56.4	36.6	" + Pb(CH ₃ COO) ₂
9.55	19.78*	"	49.0	35.69*	Pb(CH ₃ COO) ₂
8.05	21.99*	"	68.0	38.27	"
-0.3	32.97*	"	100.5	44.95	"
-3.1	37.48*	"	139.0	59.55	"
20.3	14.67	Pb.½H	165.0	71.83	"
32.8	20.57	"	204	100.00	"

* = Metastable.

Pb.½H = Pb(CH₃COO)₂·½CH₃COOH. This branch of the curve could be located only by seeding the mixtures with crystals of the salt. The solubility of this hemisolvate in acetic acid is 16.75 mol. percent or 52.16 gms. per 100 gms. sat. solution at 25°.

100 gms. Methyl Alcohol (CH₃OH) dissolve 74.75 gms. Pb(CH₃COO)₂·3H₂O at 15° and 214.95 gms. at the b. pt.

100 gms. Methyl Alcohol (CH₃OH) dissolve 102.75 gms. Pb(CH₃COO)₂ at 66.1° (b.pt.). (Henstock, 1934.)

SOLUBILITY OF LEAD ACETATE IN AQUEOUS SOLUTIONS OF ETHYL ALCOHOL AT 25°.

(Seidell, 1910.)

Wt. % C ₂ H ₅ OH in Solvent.	d ₂₅ of Sat. Sol.	Gms. (C ₂ H ₃ O ₂) ₂ Pb per 100 Gms. Sat. Sol.	Solid Phase.	Wt. % C ₂ H ₅ OH in Solvent.	d ₂₅ of Sat. Sol.	Gms. (C ₂ H ₃ O ₂) ₂ Pb per 100 Gms. Sat. Sol.	Solid Phase.
0	1.343	36.5	(C ₂ H ₃ O ₂) ₂ Pb.3H ₂ O	70	0.955	12.4	(C ₂ H ₃ O ₂) ₂ Pb.3H ₂ O
10	1.275	32.3	"	80	0.907	9.4	"
20	1.215	28.6	"	81	0.905	9	"
30	1.157	25	"	85	0.855	4	(C ₂ H ₃ O ₂) ₂ Pb
40	1.105	21.9	"	90	0.826	1.6	"
50	1.055	18.7	"	95	0.806	0.6	"
60	1.002	15.6	"	100	0.790	0.4	"

100 gms. 95% formic acid dissolve 0.99(?) gm. Pb(C₂H₃O₂)₂ at 19.8°. (Aschan, 1913.)100 gms. anhydrous lanolin (m. pt. 46°) dissolve 1.1 gm. Pb(C₂H₃O₂)₂ at 45°. (Klose, '07.)100 gms. glycerol dissolve about 20 gms. Pb(C₂H₃O₂)₂ at 15°. (Ossendowski, 1907.)100 gms. glycerol of $d = 1.2326$ ($= 86.5\%$) dissolve 129.3 gms. Pb(CH₃COO)₂ at 20°" of $d = 1.2645$ ($= 98.5\%$) " 143.0 " "

(Holm, 1921, 1921 a, 1922.)

LEAD salt (neutral) of racemic β Methyl ADIPIC ACID.

100 gms. sat. solution in water contain 0.35 gm. of the salt at 20°. (Meurisse.)

LEAD TARTRATE PbC₄O₆H₄.

SOLUBILITY IN WATER.

(Cantoni and Zachoder — Bull. soc. chim. [3] 33, 751, '05; Partheil and Hübner — Archiv. Pharm. 241, 413, '03.)

t°.	Gms. PbC ₄ O ₆ H ₄ per 100 cc. Solution.	t°.	Gms. PbC ₄ O ₆ H ₄ per 100 cc. Solution.	t°.	Gms. PbC ₄ O ₆ H ₄ per 100 cc. Solution.
18	0.010 (P. and H.)	50	0.00225	70	0.0032
25	0.0108 "	55	0.00295	75	0.0033
35	0.00105	60	0.00305	80	0.0038
40	0.0015	65	0.00315	85	0.0054

CH

NOTE. — The positions of the decimal points here shown are just as given in the original communications.

100 gms. alcohol of 0.8092 Sp. Gr. (about 95%) dissolve 0.0028 gm. PbC₄O₆H₄ at 18°, and 0.00315 gm. at 25°. (P. and H.)LEAD TARTRATES Active, PbC₄H₄O₆; Racemic, Pb₂C₈H₈O₁₂.4H₂O.

SOLUBILITY OF EACH SEPARATELY IN WATER.

(Duboux and Cattat, 1921.)

Results for the Active salt.

t°.	Gms. PbC ₄ H ₄ O ₆ per 100 gms. sat. sol.	Solid Phase.
0.....	0.0027	Pb ₂ C ₈ H ₈ O ₁₂
12.5....	0.0030	"
25.....	0.0035	"
37.5....	0.0046	"

Results for the Racemic salt.

t°.	Gms. Pb ₂ C ₈ H ₈ O ₁₂ per 100 gms. sat. sol.	Solid Phase.
0.....	0.0038	Pb ₂ C ₈ H ₈ O ₁₂ .4H ₂ O
12.5....	0.0020	"
25.....	0.0034	"
37.5....	0.0066	"

SOLUBILITY OF LEAD TARTRATE IN WATER AND IN AQUEOUS SOLUTIONS AT 18°.

(Auerbach and Weber, 1925.)

Solvent.	Gms. PbC ₄ H ₄ O ₆ per liter sat. sol.	Solvent.	Gms. PbC ₄ H ₄ O ₆ per liter sat. sol.
Water.....	0.0125 ($p_H = 5.6$)	Aq. 4.0 n CH ₃ COONa..	14.64
Aq. 0.01 n HCl..	0.526	" 1.0 n CH ₃ COONH ₄ .	1.95
" 0.10 n "	6.75	" 4.0 n "	13.02
" 1.0 n CH ₃ COONa.	1.38	" 50 wt. %/0 C ₂ H ₅ OH.	0.00

LEAD FUMARATE PbC₄H₂O₄.100 gms. H₂O dissolve 0.025 gm. Pb(C₄H₂O₄) at 30°. (Weiss and Downs, 1923.)

LEAD MALATE $\text{Pb.C}_4\text{H}_4\text{O}_6.3\text{H}_2\text{O}$.

SOLUBILITY IN WATER AND ALCOHOL.
(Partheil and Hübner, 1903.)

100 gm^s H_2O dissolve 0.0288 gm. $\text{PbC}_4\text{H}_4\text{O}_6.3\text{H}_2\text{O}$ at 18°, and 0.06504 gm. at 25°.

100 gms. 95% alcohol dissolve 0.0048 gm. $\text{PbC}_4\text{H}_4\text{O}_6.3\text{H}_2\text{O}$ at 18°-25°.
Density of alcohol employed = 0.8092.

LEAD MALATE (i) $\text{Pb}(\text{C}_4\text{H}_4\text{O}_6).1/2\text{H}_2\text{O}$.

100 cc. sat. solution of lead malate in water contain 0.0902 gm. $\text{Pb}(\text{C}_4\text{H}_4\text{O}_6)$ at 18° and the solution has $\rho_{\text{H}} = 5.9$. (Auerbach and Weber, 1925.)

100 gms. H_2O dissolve 0.21 gm. i lead malate at 30°. (Weiss and Downs, 1923.)

SOLUBILITY OF LEAD MALATE IN AQUEOUS SOLUTIONS AT 18°.
(Auerbach and Weber, 1925.)

Aqueous solution.	Gms. $\text{Pb}(\text{C}_4\text{H}_4\text{O}_6)$ per liter of sat. sol.	Aqueous solution.	Gms. $\text{Pb}(\text{C}_4\text{H}_4\text{O}_6)$ per liter of sat. sol.
0.01 <i>n</i> HCl	2.205	4.0 <i>n</i> CH_3COONa	171.2
0.10 <i>n</i> HCl	16.05	4.0 <i>n</i> $\text{CH}_3\text{COONH}_4$	300.6
1.0 <i>n</i> CH_3COONa	23.52	50 wt. per cent $\text{C}_2\text{H}_5\text{OH}$.	26.0
1.0 <i>n</i> $\text{CH}_3\text{COONH}_4$...	36.3		

SOLUBILITY OF ACTIVE AND RACEMIC LEAD MALATES IN WATER.
(Duboux and Cuttat, 1921.)

Results for Active Lead Malate.

Results for Racemic Lead Malate.

t°.	Gms. $\text{Pb}(\text{C}_4\text{H}_4\text{O}_6)$ per 100 gms. sat. sol.	Solid Phase.	t°.	Gms. $\text{Pb}_2\text{C}_8\text{H}_8\text{O}_{10}$ per 100 gms. sat. sol.	Solid Phase.
0.....	0.015	$\text{Pb}(\text{C}_4\text{H}_4\text{O}_6).2\text{H}_2\text{O}$	0.....	0.015	$\text{Pb}_2\text{C}_8\text{H}_8\text{O}_{10}.2\text{H}_2\text{O}$
12.5.....	0.027	"	12.5.....	0.023	"
25.0.....	0.052	"	25.....	0.035	"
37.5.....	0.089	"	37.5.....	0.0545	"

LEAD MALEATE $\text{PbC}_4\text{H}_2\text{O}_4$.

100 gms. H_2O dissolve 0.052 gms. $\text{PbC}_4\text{H}_2\text{O}_4$ at 30°. (Weiss and Downs, 1923.)

LEAD SUCCINATE $\text{PbC}_4\text{H}_4\text{O}_4$.

SOLUBILITY IN WATER AND IN ALCOHOL.
(Partheil and Hübner, 1903.)

100 gms. H_2O dissolve 0.0253 gm. $\text{PbC}_4\text{H}_4\text{O}_4$ at 18°, and 0.0285 gm. at 25°.

100 gms. 95% alcohol dissolve 0.00275 gm. $\text{PbC}_4\text{H}_4\text{O}_4$ at 18°, and 0.003 gm. at 25°.

Density of alcohol used = 0.8092.

SOLUBILITY OF LEAD SUCCINATE IN WATER.
(Cantoni and Diotalevi, 1905.)

t°.	10°.	21°.	32°.	39°.	50°.
Gms. $\text{PbC}_4\text{H}_4\text{O}_4$ per 100 cc. sat. sol.	0.015	0.019	0.024	0.027	0.029

SOLUBILITY OF LEAD SUCCINATE IN WATER AND IN AQUEOUS SOLUTIONS AT 18°.
(Auerbach and Weber, 1925.)

Solvent.	Gms. $\text{Pb}(\text{C}_4\text{H}_4\text{O}_4)$ per liter sat. sol.
Water.....	0.228 (the sat. sol. has $\rho_{\text{H}} = 6.1$)
Aq. 0.01 <i>n</i> HCl	2.04
" 0.10 <i>n</i> HCl	6.98
" 1.0 <i>n</i> CH_3COONa	9.60
" 1.0 <i>n</i> $\text{CH}_3\text{COONH}_4$	13.21
" 50% $\text{C}_2\text{H}_5\text{OH}$	0.017

LEAD CITRATE $\text{Pb}(\text{C}_6\text{H}_5\text{O}_7)_2 \cdot \text{H}_2\text{O}$.

SOLUBILITY IN WATER AND IN ALCOHOL.

100 gms. H_2O dissolve 0.04201 gm. $\text{Pb}(\text{C}_6\text{H}_5\text{O}_7)_2 \cdot \text{H}_2\text{O}$ at 18° , and 0.05344 gm. at 25° .

100 gms. alcohol (95%) dissolve 0.0156 gm. $\text{Pb}(\text{C}_6\text{H}_5\text{O}_7)_2 \cdot \text{H}_2\text{O}$ at 18° , and 0.0167 gm. at 25° . (Partheil and Hübner — Archiv. Pharm. 241, 413, '03.)

SOLUBILITY OF LEAD CITRATE IN WATER AND IN AQUEOUS SOLUTIONS AT 18°
(Auerbach and Weber, 1925.)

Solvent.	Gms. $\text{Pb}_2(\text{C}_6\text{H}_5\text{O}_7)_2$ per liter sat. sol.
Water.....	0.159 (p_H of sat. sol. = 6.3)
Aq. 0.01 n HCl	1.465
» 0.10 n HCl	8.28
» 1.00 n CH_3COONa	6.70
» 1.00 n $\text{CH}_3\text{COONH}_4$	6.83
» 50 wt. % $\text{C}_2\text{H}_5\text{OH}$	14.00

LEAD ERUCATE $\text{Pb}[\text{C}_{18}\text{H}_{33}\text{O}_2]_2$.

100 gms. anhydrous ethyl ether dissolve 0.408 gms. lead erucate at 25° . The presence of moisture affects this solubility greatly. (Thomas and Mattikow, 1926.)

LEAD CINNAMATE $\text{Pb} \cdot \text{C}_{18}\text{H}_{14}\text{O}_4 \cdot 2\text{H}_2\text{O}$.

100 gms. sat. solution of lead cinnamate in water contain 0.141 gm. $\text{Pb} \cdot \text{C}_{18}\text{H}_{14}\text{O}_4$ at 20° . (Ephraim and Pfister, 1925.)

LEAD GLUCONATE $\text{Pb}(\text{C}_6\text{H}_{11}\text{O}_7)_2$.

100cc sat. solution of Lead Gluconate in water contain 5.1 gms. $\text{Pb}(\text{C}_6\text{H}_{11}\text{O}_7)_2$ at 25° . (May, Weisberg, and Herrick, 1929.)

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LEAD BENZOATE $\text{Pb}(\text{C}_7\text{H}_5\text{O}_2)_2 \cdot \text{H}_2\text{O}$.

SOLUBILITY IN WATER.

(Pajetta, 1906.)

t° .	18° .	40.6° .	49° .
Gms. $\text{Pb}(\text{C}_7\text{H}_5\text{O}_2)_2$ per 100 gms. sat. sol.	0.149	0.249	0.310

SOLUBILITY OF LEAD BENZOATE IN WATER AND IN AQUEOUS SOLUTIONS AT 18° .

(Auerbach and Weber, 1925.)	
Solvent.	Gms. $\text{Pb}(\text{C}_6\text{H}_5\text{COO})_2$ per liter sat. sol.
Water.....	1.647
Aq. 0.01 n HCl	3.17
» 1.0 n CH_3COONa	14.18
Solvent.	Gms. $\text{Pb}(\text{C}_6\text{H}_5\text{COO})_2$ per liter sat. sol.
Aq. 1.0 n $\text{CH}_3\text{COONH}_4$	16.70
Aq. 50 % $\text{C}_2\text{H}_5\text{OH}$	1892.0

The sat. sol. in water had $p_H = 6.0$.

SOLUBILITY OF SEVERAL LEAD BENZOATES IN WATER AT 20° . (Ephraim and Pfister, 1925.)

Compound.	Formula.	Gms. anhydrous compd. per 100 cc. sat. sol.
Lead Benzoate.....	$\text{Pb}(\text{C}_6\text{H}_5\text{COO})_2 \cdot \text{H}_2\text{O}$	0.179
» .4.Oxy benzoate.....	$\text{Pb}(\text{C}_6\text{H}_4\text{OH} \cdot \text{COO})_2 \cdot 2\text{H}_2\text{O}$	0.470
» .4.Nitro benzoate.....	$\text{Pb}(\text{C}_6\text{H}_4 \cdot \text{NO}_2 \cdot \text{COO})_2$	0.159
» .4.Chlor benzoate.....	$\text{Pb}(\text{C}_6\text{H}_4 \cdot \text{Cl} \cdot \text{COO})_2 \cdot 2\text{H}_2\text{O}$	0.078
» .4.Methoxy benzoate.....	$\text{Pb}(\text{C}_6\text{H}_4 \cdot \text{OCH}_3 \cdot \text{COO})_2 \cdot \text{H}_2\text{O}$	0.0486

100 gms. Methyl Alcohol (CH_3OH) dissolve 1.32 gms. $\text{Pb}(\text{C}_6\text{H}_5\text{COO})_2$ at 15° and 2.65 gms. at 66° (b.pt.).

100 gms. Acetone ($(\text{CH}_3)_2\text{CO}$) dissolve 0.20 gms. $\text{Pb}(\text{C}_6\text{H}_5\text{COO})_2$ at 15° .
(Henstock, 1934.)

LEAD TetraPHENYL $\text{Pb}(\text{C}_6\text{H}_5)_4$.

Freezing-point data for $\text{Pb}(\text{C}_6\text{H}_5)_4 + \text{Si}(\text{C}_6\text{H}_5)_4$ are given by Pascal (1912).

LEAD Nitroso Phenyl HYDROXYLAMINE (Cupferronate) $\text{Pb}[\text{C}_6\text{H}_5\text{N}(\text{NO}).\text{O}]_2$.

One liter water dissolve 0.025 gm. $\text{Pb}[\text{C}_6\text{H}_5\text{N}(\text{NO}).\text{O}]_2$ at 18° . (Pinkus and Martin, 1927.)

Tri cyclo Hexyl LEAD $(\text{C}_6\text{H}_{11})_3\text{Pb}$.

100 gms. $\text{C}_2\text{H}_5\text{OH}$ dissolve 6.076 gm. $(\text{C}_6\text{H}_{11})_3\text{Pb}$ at 30° (Krause and Reiszhaus, 1921.)

" C_6H_6 " 2.28 " "

" CHCl_3 " 1.27 " "

LEAD HYDNOCARPATE $\text{Pb}(\text{CH} = \text{CH}.\text{CH}_2.\text{CH}_2.\text{CH}(\text{CH}_2)_{10}\text{COO})_2$.

CH LEAD CHAULMOOGRATE $\text{Pb}(\text{CH} = \text{CH}.\text{CH}_2.\text{CH}_2.\text{CH}(\text{CH}_2)_{12}\text{COO})_2$.

SOLUBILITY OF EACH SEPARATELY IN SEVERAL SOLVENTS.

(Cole, 1932.)

Solvent	t°	Gms. Hydnocarpate per 100 cc solvent	Gms. Chaulmoograte per 100 cc solvent
95% Ethyl Alcohol	15	0.11	0.08
"	30	0.20	0.19
"	b.pt.	1.13	0.91
Ethyl Ether	15	0.16	0.05
"	30	0.32	0.10
"	b.pt.	0.98	0.29
Benzene	15	0.09	0.05
"	30	0.15	0.06
"	b.pt.	2.92	2.42
Petroleum Ether (b.pt. $30-60^\circ$)	30	0.014	0.008

LEAD SULFONATES.

SOLUBILITY IN WATER.

Name.	Formula.	t°	Gms. Salt per 100 Gms. H_2O .	Authority.
Lead 2,5 Diiodobenzenesulfonate	$\text{C}_{12}\text{H}_2\text{O}_4\text{I}_2\text{S}_2\text{Pb}_4\text{H}_2\text{O}$	20	0.77	(Boyle, 1909.)
Lead β Naphthalene Sulfonate	$(\text{C}_{10}\text{H}_7\text{SO}_3)_2\text{Pb}.\text{H}_2\text{O}$	25	0.4	(Witte, '15; Euwens, '09.)
" α " "	$(\text{C}_{10}\text{H}_7\text{SO}_3)_2\text{Pb}.\text{H}_2\text{O}$	24.9	4.195	(Euwens, 1909.)
Lead 2 Phenanthrene Monosulfonate	H_2O	20	0.014	(Sandquist, 1912.)
" 3 " "	H_2O	20	0.08	"
" 10 " "	H_2O	20	0.14	"

SOLUBILITY OF LEAD CHLORO BENZENE SULFONATES IN WATER.

(Bollinger, 1928.)

Compound	Formula	t°	Gms. compound per 100 cc sat. sol.
Lead m chloro benzene sulfonate	$Pb[C_6H_4ClSO_3]_2$	18	0.29
" p " " " "	"	"	0.28

SOLUBILITY OF SEVERAL LEAD NAPHTHALENE AND NAPHTHYLAMINE SULFONATES IN WATER.

Compound.	Formula.	t°.	Gms. anhydrous cmpd. per	
			100 cc. sat. sol.	100 gms. H ₂ O.
Lead Naphthalene-2-sulfonate.....	$Pb(C_{10}H_7SO_3)_2 \cdot 11_2O$	16.5	0.541	— (1)
α " " mono "	$\alpha Pb(C_{10}H_7SO_3)_2 \cdot 3H_2O$	10	—	3.7 (2)
β " " " "	β " "	10	—	0.87 (2)
" " 2.6-disulfonate.....	$PbC_{10}H_6(SO_3)_2$	25	—	0.19 (3)
" " 2.7 "	" "	25	—	8.2 (3)
" " 5-chlor-1-sulfonate..	$Pb(C_{10}H_6ClSO_3)_2 \cdot 2H_2O$	20	0.20	— (1)
" " 6-oxy-2-sulfonate..	$Pb(C_{10}H_6OHSO_3)_2 \cdot 6H_2O$	20	1.814	— (1)
" Naphthylamine disulfonate-2.6.8.	$Pb(C_{10}H_6NH_2SO_3)_2$	15	—	80.19 (4)
" " " -2.5.7.	" "	15	—	92.66 (4)

(1) Ephraim and Pfister, 1925 a.

(2) Haller and Lynch, 1924.

(3) Merz and Mülhauser, 1870.

(4) Braunschweig, 1922, 1926.

SOLUBILITY OF LEAD β NAPHTHALENE MONO SULFONATE IN AQUEOUS SOLUTIONS OF LEAD α NAPHTHALENE MONO SULFONATE AT 24° 9.

(Euwes, 1909.)

Gms. α salt. added per 100 cc.	Gms. total α and β salt. found per 100 cc.	Gms. β salt dissolved per 100 cc. sat. sol.
0.00	0.407	0.407
0.095	0.468	0.373
0.189	0.539	0.350
0.284	0.604	0.320
0.473	0.738	0.265
0.945	1.114	0.169
1.890	1.969	0.079

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These results were used as the basis of a method for the analysis of unknown mixtures of α and β naphthalene mono sulfonic acids. The unknown mixture was converted to the lead salt and its solubility compared with the above results.

SOLUBILITY OF LEAD NAPHTHALENE 2.6 DISULFONATE IN AQUEOUS SOLUTIONS OF LEAD NAPHTHALENE 2.7 DISULFONATE AT 25°.

(Haller and Lynch, 1924.)

An excess of the 2.6 salt was constantly agitated in a thermostat for 24 hours with 100 cc. of H₂O containing increasing amounts of the 2.7 salt.

Gms. anhydrous Lead 2.7 salt per 100 cc.	Gms. total 2.7 and 2.6 salt per 100 cc. sat. sol.	Gms. dissolved 2.6 salt per 100 cc.
0.0	0.188	0.188
0.395	0.483	0.088
0.98	1.045	0.065
1.58	1.595	0.015
2.56	2.200	0.000

LEAD PHTHALATE $\text{PbC}_6\text{H}_4(\text{COO})_2$.

Data for the solubility of lead phthalate in water are given by Blecka, 1919.

Normal **LEAD Trinitro RESORCINOLATE**.

100 gms. glycol diacetate ($\text{CH}_2\text{COOCH}_2 - \text{CH}_2\text{OOCCH}_2$) dissolve 0.1 gm. normal lead trinitro resorcinolate at 20-25°. (Taylor and Rinkenbach, 1926.)

LEAD STEARATE $\text{Pb}[\text{CH}_3(\text{CH}_2)_{16}\text{COO}]_2$.

100 cc. chloroform sat. at ord. temp. with Lead Stearate contain from 0.0056 to 0.0094 gm. stearic acid.

100 cc. ethyl ether sat. at ord. temp. with Lead Stearate contain from 0.019 to 0.021 gm. stearic acid.

Approx. determinations of the solubility of lead salts of other fatty acids in a mixture of 3 vols of CHCl_3 and 1 vol. of acetone at 0° are also given.

(Strauli, 1918, 1926.)

100 gms. anhydrous ether dissolve 0.021 gms. lead stearate at 25°.

(Thomas and Yu, 1923.)

LEAD PALMITATE $\text{Pb}(\text{C}_{16}\text{H}_{31}\text{O}_2)_2$.

100 gms. of a sat. sol. of lead palmitate in turpentine contain 0.106 gms. $\text{Pb}(\text{C}_{16}\text{H}_{31}\text{O}_2)_2$ at 15°.

(Morrell, 1918.)

LEAD OLEATE $\text{Pb}(\text{C}_{18}\text{H}_{33}\text{O}_2)_2$.

CH 100 gms. anhydrous ether dissolve 9.59 gms. $\text{Pb}(\text{C}_{18}\text{H}_{33}\text{O}_2)_2$ at 25°.

(Thomas and Yu, 1923.)

LEAD LAURATE, MYRISTATE, PALMITATE and STEARATE.

SOLUBILITY OF EACH IN SEVERAL SOLVENTS.

(Jacobson and Holmes, 1916.)

(See Lithium Laurate, p. 907, for formulas and other details.)

Solvent.	t°.	Gms. of Each Salt (Determined Separately) per 100 Gms. Solvent.			
		Pb Laurate.	Pb Myristate.	Pb Palmitate.	Pb Stearate.
Water	35	0.009	0.005	0.005	0.005
"	50	0.007	0.006	0.007	0.006
Abs. Ethyl Alcohol	25	0.009	0.004	0	0
" " "	35	0.032	0.004	0.001	0.001
" " "	50	0.264	0.052	0.012	0.004
Methyl Alcohol	15.5	0.061	0.056	0.051	0.039
" "	25	0.096	0.078	0.069	0.051
" "	35	0.113	0.082	0.076	0.062
" "	50	0.280	0.119	0.093	0.083
Ether	14.5	0.010	0.013	0.010	0.007
Ethyl Acetate	14	0.017	0.010	0.009	0.007
" "	35.5	0.035	0.015	0.009	0.008
" "	50	0.201	0.077	0.033	0.020
Benzene	15	0.011	0.010	0.009	0.008

LEAD CAPROATE, CAPRYLATE, CAPRATE, etc.

SOLUBILITY OF EACH IN ETHER AND IN PETROLEUM ETHER.
(Neave, 1912.)

Lead Salt.	Melting point.	Solubility in Ethyl Ether.		Solubility in Pet. Ether.	
		Gms. Salt per 100 cc. Sat. Sol.		Gms. Salt per 100 cc. Sat. Sol.	
		At 20°.	At B. pt. of Sat. Sol.	At 20°.	At B. pt. of Sat. Sol.
Pb Caproate	73-74	...	1.364	...	0.0608
" Heptylate	90.5-91.5	0.2397	1.490	0.020	0.0528
" Caprylate	83.5-84.5	0.0938	0.546	practically insol.	0.0384
" Nonylate	94-95	0.1115	0.2404	"	0.0450
" Caprate	100	0.0290	0.4285	"	0.0170
" Myristate	107	practically insol.	0.0555	"	0.0210
" Laurate	103-104	"	0.0205	"	practically insol.
" Palmitate	112	"	0.0261	"	"
" Stearate	125	"	practically insol.	"	0.0170

The ethyl ether was distilled over sodium. Petroleum ether distilling between 40°-60° was used. The solutions were stirred constantly at 20°. A definite volume of the sat. solution was evaporated to dryness and residue weighed in each case.

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LEAD HELIANTHATE $\text{Pb}(\text{C}_{14}\text{H}_{14}\text{N}_3\text{SO}_3)_2 \cdot 4\text{H}_2\text{O}$.

1000 cc. H_2O dissolve 0.111 gm. lead helianthate (= 0.08 gm. helianthine) at 20°-25°. (Stark and Dehn, 1918.)

LEAD LIGNOCERATE.

100 gms. anhydrous ether dissolve 0.025 gm. lead lignocerate at 25°.

(Thomas and Yu, 1923.)

LEAD CYANIDE $\text{Pb}(\text{CN})_2$

100 gms. Liquid Sulfur Dioxide (SO_2) dissolve 0.01 gm. $\text{Pb}(\text{CN})_2$ at 0°. (Jander and Ruppolt, 1937.)

LEAD DOUBLE CYANIDES.**SOLUBILITY IN WATER.**

(Schuler — Sitzber. Akad. Wiss. Wien, 79, 302, '79.)

Double Salt.	Formula.	t°.	Gms. per 100 Gms. H_2O .
Lead Cobaltcyanide	$\text{Pb}_2[\text{Co}(\text{CN})_6]_2 \cdot 7\text{H}_2\text{O}$	18	56.5
Lead Cobaltcyanide	$\text{Pb}_2[\text{Co}(\text{CN})_6]_2 \cdot 7\text{H}_2\text{O}$	19	61.3
Lead Potassium Cobaltcyanide	$\text{PbKCo}(\text{CN})_6 \cdot 3\text{H}_2\text{O}$	18	14.8
Lead Cobaltcyanide Nitrate	$\text{Pb}_2[\text{Co}(\text{CN})_6]_2 \cdot \text{Pb}(\text{NO}_3)_2 \cdot 12\text{H}_2\text{O}$	18	5.9
Lead Ferricyanide Nitrate	$\text{Pb}_2[\text{Fe}(\text{CN})_6]_2 \cdot \text{Pb}(\text{NO}_3)_2 \cdot 12\text{H}_2\text{O}$	16	7.5
Lead Potassium Ferricyanide	$\text{PbKFe}(\text{CN})_6 \cdot 3\text{H}_2\text{O}$	16	21.0

CN

LEAD THIOCYANATE $\text{Pb}(\text{SCN})_2$.

One liter water dissolves 0.0137 gm. mol. $\text{Pb}(\text{SCN})_2$ at 18°, as determined by E.M.F. measurements. (Masaki, 1931.)

100 gms. Liquid Sulfur Dioxide (SO_2) dissolve 0.012 gm. $\text{Pb}(\text{SCN})_2$ at 0°. (Jander and Ruppolt, 1937.)

LEAD CARBONATE PbCO_3 .

SOLUBILITY IN WATER BY ELECTRICAL CONDUCTIVITY METHOD.

(Kohlrausch and Rose, 1893; Böttger, 1903.)

1 liter of water dissolves 0.0011—0.0017 gm. PbCO_3 at 20°.

SOLUBILITY OF LEAD CARBONATE (NEUTRAL) IN AQUEOUS SOLUTIONS OF CARBON DIOXIDE AT 18°.

(Pleissner, 1907.)

Millimols per Liter.		Milligrams per Liter.	
CO_2 .	PbCO_3 .	CO_2 .	PbCO_3 .
0	0.008	0	1.75
0.064	0.029	2.8	6
0.123	0.034	5.4	7
0.328	0.040	14.4	8.2
0.592	0.048	26	9.9
0.988	0.053	43.5	10.9
2.40	0.076	106	15.4

A determination of the solubility of basic lead carbonate in water gave 1.6 mg. $\text{Pb}_3(\text{CO}_3)_2(\text{OH})_2$ per liter = 1.3 mg. Pb or 0.006 millimol Pb.

LEAD CARBONATE PbCO_3 .

100 gms. of a sat. solution of lead carbonate in water at 18° and in contact with CO_2 at a pressure of 1 atmosphere, contain 0.014 gm. PbCO_3 . At a pressure of 56 atmospheres of CO_2 , 0.015 gm. PbCO_3 are dissolved. (Haehnel, 1924.)

CO SOLUBILITY OF LEAD CARBONATE AND OTHER LEAD SALTS IN BLOOD SERUM AT 25°.

(Fairhall, 1924a.)

An excess of metallic lead or of the lead salt was added to 250 cc. bottles containing fresh horse serum preserved with a small amount of thymol. The bottles were rotated for 24 hours in a thermostat at 25°. The undissolved solid was thrown down by centrifugation and portions of the clear sat. solution were analyzed by evaporating, ashing, converting the lead to chromate and titrating with 0.005 N thiosulfate solution.

Lead compound employed.	Gms. lead compd. per liter of Serum at 25°.	Comparative solubility in Water.
Lead carbonate (PbCO_3)..	0.0333 (0.0125)	0.0017 at 18° as det. by Pleissner
» sulfate (PbSO_4)....	0.0437 (0.0300)	0.044 at 24°.95 as det. by Böttger
» chromate PbCrO_4 ..	—	0.00001 at 25° as det. by von Hevesy
» oxide PbO	1.1520 (1.1600)	0.0171 at 20° as det. by Pleissner
» Pb.....	0.578 (0.193)	

The results in parentheses were obtained by saturating the fresh serum suspensions of the solid with CO_2 at 25°, and determining the solubility as above. The high value for Pb O is due to the formation of lead hydroxide, which is removed by protein with, which it combines to form an alkali metaprotein.

LEAD CARBONATE (Basic) $\text{Pb}_3(\text{CO}_3)_2(\text{OH})_2$.

Results for the solubility of basic lead carbonate and of lead oxides in aqueous potassium hydroxide solutions at 25° are given by Randall and Spencer, 1928. "The change of the stoichiometrical equilibrium constant with concentration show that the activity coefficient of the plumbite ion is about the same as that of the nitrate ion in dilute solutions. From the extrapolated values of the equilibrium constants, the free energies of the solutions have been calculated."

LEAD OXALATE PbC_2O_4 .

One liter of water dissolves 0.0015 gm. PbC_2O_4 at 18° (conductivity method). (Böttger — Z. physik. Chem. 46, 602, '03; Kohlrausch — *Ibid* 50, 356, '04-'05.)

LEAD Sub CHLORIDE PbCl .

1000 cc. sat. solution of lead subchloride in water contain 2.2 milli equivalents PbCl at 25° as determined by the conductivity method. (Denham, 1918.)

LEAD CHLORIDE PbCl_2 .

SOLUBILITY IN WATER. (Lichty; see also Formanek, 1887; Bell, 1867; Ditte, 1881.)

t°.	Density of Solutions, H_2O at 0°.	Gms. PbCl_2 per 100		Milligram Mols. PbCl_2 per 100	
		cc. Solution.	Gms. H_2O .	cc. Solution.	Grams H_2O .
0	1.0066	0.6728	0.6728	2.421	2.421
15	1.0069	0.9070	0.9090	3.265	3.272
25	1.0072	1.0786	1.0842	3.882	3.903
35	1.0060	1.3150	1.3244	4.733	4.767
45	1.0042	1.5498	1.5673	5.579	5.644
55	1.0020	1.8019	1.8263	6.486	6.573
65	0.9993	2.0810	2.1265	7.490	7.651
80	0.9947	2.5420	2.6224	9.150	9.439
95	0.9894	3.0358	3.1654	10.926	11.394
100	...	3.208	3.342	11.52	12.01

Cl

More recent determinations of the solubility of Lead Chloride in Water as follows.

t°	Gms. PbCl_2 per 100 gms. sat. sol.	Solid Phase	t°	Gms. PbCl_2 per 100 gms. sat. sol.	Solid Phase
15	0.85 (1)	PbCl_2	25	1.028 (4)	PbCl_2
15 (1.0071)	0.876 (2)	"	25	1.083 (5) (6)	"
20 (1.0070)	0.971 (2)	"	30	1.17 (7)	"
25 (1.0069)	1.076 (2)	"	50	1.75 (1)	"
25	1.075 (3)	"	100	3.10 (1)	"

(1) Demassieux, 1923; (2) Flöttmann, 1928; (3) Deacon, 1927; (4) Weber, 1929; (5) Bura, 1926; (6) Herz and Hellebrandt, 1923; (7) Sowerby, 1927.

SOLUBILITY OF LEAD CHLORIDE IN WATER AT TEMPERATURES ABOVE 100° .

(Benrath, Gjedebo, Schiffrs and Wunderlich, 1937.)

t°	Gms. PbCl_2 per 100 gms. sat. sol.	t°	Gms. PbCl_2 per 100 gms. sat. sol.	t°	Gms. PbCl_2 per 100 gms. sat. sol.
141	4.74	230	11.3	345	24-76*
160	5.67	257	14.3	351	81.2
187	7.39	276	16.7	362	87.8
195	8.47	287	18.4	407	84.4

* Two liquid layers are formed and there is present salt solution, melt and vapor.

LEAD CHLORIDE (Basic).

SOLUBILITY OF BASIC LEAD CHLORIDES IN WATER AT 18°. (Pleissner, 1907.)

Compound	Formula.	Gms. per Liter Sat. Aq. Solution.	
		Pb	Pb Salt.
$\frac{1}{2}$ Basic Lead Chloride	$\text{PbCl}_2 \cdot \text{PbO} \cdot \text{H}_2\text{O}$	0.079	0.099
$\frac{3}{4}$ " " "	$\text{PbCl}_{2.3} \text{PbO} \cdot \text{H}_2\text{O}$	0.021	0.025

SOLUBILITY OF LEAD CHLORIDE IN AQUEOUS SOLUTIONS OF BARIUM BROMIDE AT 25°. (Herz and Hellebrandt, 1923).

Normality of $\frac{\text{Ba Br}_2}{2}$	0.45.	0.91.	1.83.	2.70.	3.67.
Mols. Pb per liter	0.00603	0.01096	0.03858	0.1267	0.2960

SOLUBILITY OF LEAD CHLORIDE IN AQUEOUS SOLUTIONS OF BARIUM CHLORIDE AT 25°.

Results of Herz and Hellebrandt, 1923.			Results of Kendall and Sloan, 1925.		
Normality of $\frac{\text{Ba Cl}_2}{2}$.	Mols Pb per liter.	Gm. equiv. per liter.	Gm. equiv. per liter.	Gm. equiv. per liter.	Gm. equiv. per liter.
		[Ba Cl ₂]. [Pb Cl ₂].	[Ba Cl ₂]. [Pb Cl ₂].	[Ba Cl ₂]. [Pb Cl ₂].	[Ba Cl ₂]. [Pb Cl ₂].
0.32	0.00699	0.10 0.02322	1.54 0.02820	2.56 0.04600	
0.64	0.00553	0.20 0.02000	1.86 0.03275	2.76 0.05135	
1.38	0.01089	0.50 0.01966	2.02 0.03524	2.90 0.05598	
2.08	0.02388	0.96 0.02180	2.10 0.03662	2.98 0.05922	
		1.09 0.02322	2.30 0.04030	3.12 0.06600	
		1.35 0.02600	2.45 0.04361	3.26 0.07362	

Solid Phase $\text{Ba Cl}_2 \cdot \text{Pb Cl}_2$ in all cases.

SOLUBILITY OF LEAD CHLORIDE IN AQUEOUS SOLUTIONS OF CALCIUM BROMIDE AT 25°. (Herz and Hellebrandt, 1923.)

Normality of $\frac{\text{Ca Br}_2}{2}$	0.17.	0.95.	1.91.	2.85.	3.81.
Mols Pb per liter	0.00681	0.01065	0.03787	0.09418	0.2173

SOLUBILITY OF LEAD CHLORIDE IN AQUEOUS SOLUTIONS OF CALCIUM CHLORIDE AT 25°.

Results of Herz and Hellebrandt, 1923.			Results of Kendall and Sloan, 1925.		
Normality of $\frac{\text{Ca Cl}_2}{2}$.	Mols. Pb per liter.	Gm. equiv. per liter.	Gm. equiv. per liter.	Gm. equiv. per liter.	Gm. equiv. per liter.
		[Ca Cl ₂]. [Pb Cl ₂].	[Ca Cl ₂]. [Pb Cl ₂].	[Ca Cl ₂]. [Pb Cl ₂].	[Ca Cl ₂]. [Pb Cl ₂].
0.52	0.00696	0.20 0.02402	2.10 0.02480	4.60 0.04260	
0.95	0.00563	0.50 0.02144	2.19 0.02522	5.02 0.04903	
1.91	0.00771	0.70 0.02100	2.38 0.02601	5.18 0.05202	
3.63	0.01268	0.94 0.02122	2.80 0.02807	5.27 0.05400	
4.12	0.02057	1.18 0.02106	3.44 0.03227	5.43 0.05831	
		1.52 0.02208	3.63 0.03660	5.62 0.06500	
		1.84 0.02350	4.06 0.03655	5.68 0.06821	

Solid Phase $\text{Ca Cl}_2 \cdot \text{Pb Cl}_2 \cdot 6\text{H}_2\text{O}$ in all cases.

SOLUBILITY OF LEAD CHLORIDE IN AQUEOUS SOLUTIONS OF HYDROCHLORIC ACID.

(At 0°, Engel — Ann. chim. phys. [6] 17, 350, '89; at 25°, Noyes — Z. physik. Chem. 9, 623, '02; at different temperatures, Ditte — Compt. rend. 92, 718, '81; see also Bell — J. Chem. Soc. 21, 350, '68.)

Gms. HCl per Liter.	Gms. PbCl ₂ per Liter at:		Gms. HCl per 1000 Gms. H ₂ O.	Gms. PbCl ₂ per 1000 Gms. Solution at:				
	0°.	25°.		0°.	20°.	40°.	55°.	80°.
0	5.83	10.79	0	8.0	11.8	17.0	21.0	31.0
0.5	4.5	9.0	100	1.2	1.4	3.2	5.5	12.0
1.0	3.6	7.6	150	1.5	2.0	5.0	7.5	16.0
2.0	2.2	6.0	200	3.5	5.0	8.2	11.7	21.5
3.0	1.6	5.0	250	6.5	8.0	13.0	16.2	28.5
6	1.4	3.1	300	10.7	12.5	17.5	22.0	35.0
10	1.2	1.8	400	21.5	24.0	...	...	...
100	1.2	...						
200	5.2	...						
250	10.5	...						
300	17.5	...						
400	40.0	...						

SOLUBILITY OF LEAD CHLORIDE IN AQUEOUS SOLUTIONS OF HYDROCHLORIC ACID. (Wilkerson, Bathurst and Parton, 1937.)

Results at 50°

Results at 80°

Gms. per 1000 gms. H ₂ O		Gms. per 1000 gms. H ₂ O		Gms. per 1000 gms. H ₂ O		Gms. per 1000 gms. H ₂ O	
HCl	PbCl ₂	HCl	PbCl ₂	HCl	PbCl ₂	HCl	PbCl ₂
0.138	16.30	81.86	3.99	0.563	23.71	89.45	8.95
0.639	14.35	165.40	7.82	0.786	23.05	114.0	11.71
1.917	11.57	184.00	9.27	2.375	19.50	147.0	14.24
3.98	9.24	365.00	18.31	5.058	15.00	201.2	20.21
14.20	4.46	331.80	27.50	10.90	11.49	221.3	22.71
38.91	3.46	377.80	38.16	18.90	9.59	286.8	34.77
45.52	3.25	444.4	54.12	33.16	7.52	372.5	54.23
		476.0	61.23	67.82	7.57	378.1	58.37

SOLUBILITY OF LEAD CHLORIDE IN AQUEOUS SOLUTIONS OF HYDROCHLORIC ACID.

Results at 18°. (Pleissner, 1907.)

Results at 25.2°. (von Ende, 1901.)

Normality of HCl.	Gms. PbCl ₂ per Liter.	Normality of HCl.	Millimols PbCl ₂ per Liter.	Normality of HCl.	Millimols PbCl ₂ per Liter.
0	9.34	0	38.8	1.026	4.41
0.0001	9.305	0.0045	37.35	2.051	5.18
0.0002	9.300	0.0151	33.75	3.085	7.78
0.0005	9.243	0.0452	25.46	5	19.38
0.00102	9.200	0.1850	10.25	7.5	65.86
0.0102	8.504	0.5142	5.37	12.05	164.30

SOLUBILITY OF LEAD CHLORIDE IN AQUEOUS SOLUTIONS OF HYDROCHLORIC ACID AT 25°. (Kendall and Sloan, 1925.)

Gm. equiv. per liter.		Gm. equiv. per liter.		Gm. equiv. per liter.		Gm. equiv. per liter.	
[HCl].	[PbCl ₂].	[HCl].	[PbCl ₂].	[HCl].	[PbCl ₂].	[HCl].	[PbCl ₂].
0.20	0.01320	1.72	0.01014	2.90	0.01180	4.70	0.01812
0.30	0.01180	1.86	0.01023	3.25	0.01247	5.16	0.02161
0.50	0.01020	2.04	0.01042	3.52	0.01330	5.50	0.02500
0.08	0.00984	2.09	0.01060	3.58	0.01340	5.60	0.02611
1.00	0.00981	2.57	0.01126	4.02	0.01495	5.78	0.02802
1.30	0.00985			4.30	0.01604		

SOLUBILITY OF LEAD CHLORIDE IN AQUEOUS SOLUTIONS OF MERCURIC CHLORIDE
AT 25°. (Kendall and Sloan, 1925.)

Gm. equiv. per liter		Solid Phase.
[Hg Cl ₂].	[Pb Cl ₂].	
0.06	0.0885	Hg Cl ₂ . Pb Cl ₂
0.10	0.0983	»
0.15	0.1074	»
0.50	0.1384	»

SOLUBILITY OF LEAD CHLORIDE IN AQUEOUS SOLUTIONS OF POTASSIUM BROMIDE
AT 25°. (Herz and Hellebrandt, 1923.)

Normality of KBr.....	0.53	1.07	2.14	3.21	4.28
Mols. Pb per liter.....	0.00789	0.00888	0.02577	0.06705	0.1774

SOLUBILITY OF LEAD CHLORIDE IN AQUEOUS SOLUTIONS OF POTASSIUM CHLORIDE
AT 25°. (Burrage, 1926.)

Constant agitation in a thermostat was employed and great care exercised to insure that equilibrium had been attained. The solid phases were analyzed by the « rest method ».

Cl	Gms. per 100 gms. sat. sol.		Solid Phase.	Gms. per 100 gms. sat. sol.		Solid Phase.
	K Cl.	Pb Cl ₂ .		K Cl.	Pb Cl ₂ .	
	0.0	1.083	Pb Cl ₂	7.048	0.128	K Cl. 2 Pb Cl ₂
	0.037	1.008	»	9.787	0.127	»
	0.075	0.961	»	12.93	0.142	»
	0.152	0.877	»	18.74	0.236	» + K Cl. Pb Cl ₂ . 1/3 H ₂ O
	0.296	0.747	»	22.54	0.303	K Cl. Pb Cl ₂ . 1/3 H ₂ O
	0.735	0.462	»	26.43	0.386	» + K Cl
	1.469	0.301	»	26.52	0.267	K Cl
	3.022	0.205	»	26.44	0.122	»
	4.969	0.227	» + K Cl. 2 Pb Cl ₂	26.53	0.00	»

Subsequent determinations upon this system at 25° by Burrage, 1932, and Allmand and Burrage, 1933, gave the following results.

Gms. per 1000 gms. H ₂ O		Solid Phase	Gms. per 1000 gms. H ₂ O		Solid Phase
KCl	PbCl ₂		KCl	PbCl ₂	
0.0	10.94	PbCl ₂	130	1.49	2 PbCl ₂ . KCl
7.5	4.70	"	182	2.04	"
15.0	3.05	"	231	2.91	" + PbCl ₂ . KCl 1/3 H ₂ O
30.0	2.31	"	265	3.41	PbCl ₂ . KCl. 1/3 H ₂ O
35.0	2.22	"	299	4.04	"
40.0	2.18	"	330	4.65	"
47.0	2.30	"	361	5.25	" + KCl
52.5	2.39	"	362.5	4.0	KCl
55.0	2.49	"	361	2.0	"
59.0	2.70	" + 2 PbCl ₂ . KCl	360	1.0	"
75.0	2.35	2 PbCl ₂ . KCl	359	0.125	"

SOLUBILITY OF LEAD CHLORIDE IN AQUEOUS SOLUTIONS OF POTASSIUM CHLORIDE AT 25.2°. (von Ende, 1901.)

Normality of KCl.	Gm. Equiv. PbCl ₂ per Liter.	Normality of KCl.	Gm. Equiv. PbCl ₂ per Liter.
0	0.07760	0.0999	0.02380
0.001	0.07664	0.5006	0.01480
0.0025	0.07570	0.7018	0.01476
0.0049	0.07404	0.9991	0.00980
0.0099	0.07056	1.5018	0.00996
0.0200	0.06432	2.0024	0.01112
0.0599	0.04524	3.0036	0.01948

SOLUBILITY OF LEAD CHLORIDE IN AQUEOUS SOLUTIONS OF POTASSIUM CHLORIDE AT 20°. (Brönsted, 1912.)

Gm. Equivalents per 1000 Gms. Solution.		Solid Phase.	Gm. Equivalents per 1000 Gms. Solution.		Solid Phase.
KCl.	PbCl ₂ .		KCl.	PbCl ₂ .	
0.195	0.01900	PbCl ₂	2.10	0.01022	2PbCl ₂ .KCl
0.299	0.01452	"	2.20	0.01060	"
0.375	0.01324	"	2.20	0.01184	"
0.483	0.01236	"	2.36	0.01300	2PbCl ₂ .KCl + PbCl ₂ .KCl.½H ₂ O
0.510	0.0125	" + 2PbCl ₂ .KCl	2.45	0.01308	PbCl ₂ .KCl.½H ₂ O
0.575	0.01068	2PbCl ₂ .KCl	2.66	0.01396	"
0.639	0.00954	"	2.77	0.01476	"
0.930	0.00770	"	2.91	0.01550	"
1.224	0.00736	"	3.05	0.01656	"
1.575	0.00786	"	3.18	0.01780	"
1.884	0.00894	"	4.57*	0.0280*	" + KCl

* = Gm. equivalents per 1000 Gms. H₂O.

Data for the solubility of lead chloride in aqueous KCl and aqueous NaCl are given by Demassieux, 1914.

Cl

SOLUBILITY OF LEAD CHLORIDE IN AQUEOUS SOLUTIONS OF POTASSIUM CHLORIDE AT 23°. (Kendall and Sloan, 1925.)

Gms. equiv. per liter		Solid Phase.	Gms. equiv. per liter		Solid Phase.	Gms. equiv. per liter		Solid Phase.
[KCl].	[PbCl ₂].		[KCl].	[PbCl ₂].		[KCl].	[PbCl ₂].	
0.25	0.01850	PbCl ₂	0.78	0.01063	1.2	2.07	0.01287	1.2
0.37	0.01600	"	0.97	0.00981	"	2.17	0.01388	"
0.46	0.01422	"	1.10	0.00960	"	2.26	0.01489	1.1
0.52	0.01362	"	1.20	0.00960	"	2.41	0.01480	"
0.54	0.01354	"	1.30	0.00965	"	2.65	0.01601	"
0.63	0.01277	1.2	1.55	0.01025	"	2.98	0.01943	"
0.74	0.01102	"	1.80	0.01134	"	3.00	0.01966	"
					"	3.20	0.02402	"

1.2 = KCl.2PbCl₂; 1.1 = KCl.PbCl₂.

SOLUBILITY OF LEAD CHLORIDE IN AQUEOUS SOLUTIONS OF POTASSIUM CHLORIDE.
 (Demassieux, 1923.)

Results at 14°.		Results at 50°.		Results at 100°.		Solid Phase at each temp.
Gms. per 100 gms. sat. sol.		Gms. per 100 gms. sat. sol.		Gms. per 100 gms. sat. sol.		
K Cl.	Pb Cl ₂ .	K Cl.	Pb Cl ₂ .	K Cl.	Pb Cl ₂ .	Pb Cl ₂
0.0	0.91	0.0	1.75	0.0	3.10	
1.37	0.18	2.0	0.65	2.0	2.00	"
2.44	0.14	4.0	0.5	4.0	1.75	"
3.43	0.13	6.0	0.57	6.0	1.78	"
-	-	-	-	8.0	2.00	"
-	-	-	-	10.0	2.38	"
3.79	0.15	6.4	0.62	10.6	2.57	" + 2. I
4.0	0.13	12.0	0.50	12.0	2.42	2. I
4.7	0.08	14.0	0.52	14.0	2.32	"
12.75	0.08	16.0	0.55	16.0	2.35	"
15.65	0.10	18.0	0.62	18.0	2.50	"
15.87	0.11	20.0	0.70	20.0	2.75	"
16.26	0.11	22.0	0.85	22.0	3.10	"
-	-	-	-	24.0	3.50	"
-	-	-	-	26.0	4.25	"
16.83	0.12	22.8	0.97	27.2	5.00	" + 1. I. 1/3
17.57	0.13	28.0	1.10	28.0	4.90	1. I. 1/3
18.64	0.14	30.0	1.27	30.0	5.10	"
18.97	0.15	-	-	32.0	5.45	"
22.45	0.17	-	-	34.0	5.80	"
24.61	0.20	31.24	1.5	35.3	6.05	" + K Cl
-	-	31.0	1.0	35.0	3.5	K Cl
-	-	31.0	0.5	35.2	1.25	"
24.52	0.0	31.07	0.0	35.5	0.0	"

2. I = 2 Pb Cl₂. K Cl;1. I. 1/3 = Pb Cl₂. K Cl. 1/3 H₂O.

The author's numerous determinations were plotted and the above values read from the average curve.

 SOLUBILITY OF LEAD CHLORIDE IN AQUEOUS SOLUTIONS OF LITHIUM CHLORIDE
 AT 25°. (Kendall and Sloan, 1925.)

Gm. equiv. per liter.		Gm. equiv. per liter.		Gms. per 100 gms. sat. sol.		Gms. per 100 gms. sat. sol.	
[Li Cl].	[Pb Cl ₂].	[Li Cl].	[Pb Cl ₂].	Li Cl.	Pb Cl ₂ .	Li Cl.	Pb Cl ₂ .
0.28	0.02565	2.10	0.04300	2.06	0.45	37.51	7.53
0.32	0.02500	2.26	0.04729	4.79	0.35	38.52	7.55
0.52	0.02384	2.40	0.05144	5.07	0.37	39.40	7.62
0.74	0.02449	2.58	0.05723	9.59	0.49	40.50	7.45
0.91	0.02582	2.68	0.06086	16.10	0.83	43.99	7.42
1.28	0.02945	2.72	0.06317	24.64	2.31	45.51	6.66
1.55	0.03306	2.75	0.06507	30.61	5.08	46.22	6.50
1.81	0.03720	2.82	0.06930	35.05	6.80	47.72	3.39
				36.69	7.46	48.41	2.22

Solid Phase; Li Cl.₂ Pb Cl₂ in all cases.

A double salt was not found.

SOLUBILITY OF LEAD CHLORIDE IN AQUEOUS SALT SOLUTIONS AT 25°.

(Noyes; in HgCl₂ solutions at 20°, Formanek — Chem. Centralb. 270, '87.)

In Aqueous Solutions of:

HCl, KCl, MgCl ₂ , CaCl ₂ , MnCl ₂ and ZnCl ₂ Gram Equivalents per Liter of:		In CdCl ₂ Gram Equiv. per Liter.		In HgCl ₂ Gram Equiv. per Liter.		In Pb(NO ₃) ₂ Gram Equiv. per Liter.	
Salt.	PbCl ₂ .	CdCl ₂ .	PbCl ₂ .	HgCl ₂ .	PbCl ₂ .	Pb(NO ₃) ₂ .	PbCl ₂ .
0.0	0.0777	0.00	0.0777	0.0	0.0777	0.0	0.0777
0.05	0.050	0.05	0.0601	0.1	0.0992	0.2	0.0832
0.10	0.035	0.10	0.0481				
0.20	0.021	0.20	0.0355				

The above results were calculated to grams per liter plotted on cross-section paper, and the figures in the following table read from the curves.

Gm. Salt per Liter.	Grams PbCl ₂ per Liter in Aqueous Solutions of:									
	HCl.	KCl.	MgCl ₂ .	CaCl ₂ .	MnCl ₂ .	ZnCl ₂ .	CdCl ₂ .	HgCl ₂ .	Pb(NO ₃) ₂ .	
0	10.79	10.79	10.79	10.79	10.79	10.79	10.79	10.79(N) 9.71(F)	10.79	
1	8.5	9.3	7.7	8.7	9.5	...	10.2	11.0	9.8	10.8
2	6.5	8.2	6.5	7.6	8.3	...	9.7	11.4	10.0	10.85
3	5.2	7.2	5.7	6.7	7.3	...	9.2	11.7	10.3	10.87
4	4.3	6.5	5.2	6.0	6.3	...	8.6	12.0	10.5	10.90
6	3.2	5.3	4.4	4.8	5.0	...	7.7	12.7	11.0	10.95
8	2.5	4.5	...	3.9	4.1	...	7.0	13.3	11.6	11.00
10	2.1	3.9	...	3.3	3.5	...	6.3	14.0	12.2	11.05
14	...	3.1	...	...	2.8	3.0	5.4	...	13.2	11.15
20	...	...	...	...	...	...	4.7	...	14.8	11.20
40	...	...	...	...	...	...	...	...	19.0	11.70

Cl

SOLUBILITY OF LEAD CHLORIDE IN AQUEOUS SOLUTIONS OF MAGNESIUM CHLORIDE AT 25°. (Kendall and Sloan, 1925.)

Gm. equiv. per liter		Gm. equiv. per liter		Gm. equiv. per liter		Gm. equiv. per liter	
[Mg Cl ₂].	[Pb Cl ₂].	[Mg Cl ₂].	[Pb Cl ₂].	[Mg Cl ₂].	[Pb Cl ₂].	[Mg Cl ₂].	[Pb Cl ₂].
0.12	0.01084	1.83	0.00723	4.86	0.01832	7.08	0.04844
0.27	0.00802	2.62	0.00915	5.42	0.02303	7.58	0.05944
0.60	0.00625	3.54	0.01205	5.94	0.02902	7.98	0.07000
0.85	0.00618	3.87	0.01329	6.36	0.03489	8.12	0.07360
1.58	0.00689	4.36	0.01564	6.78	0.04251		

Solid Phase MgCl₂·PbCl₂·6H₂O in all cases.

SOLUBILITY OF LEAD CHLORIDE IN AQUEOUS AMMONIUM CHLORIDE AT 22°. (Brönsted, 1911.)

Gm. Equivalents per Liter.		Solid Phase.	Gm. Equivalents per Liter.		Solid Phase.
NH ₄ Cl.	PbCl ₂ .		NH ₄ Cl.	PbCl ₂ .	
0	0.0749	PbCl ₂	0.8	0.0087	NH ₄ Cl·2PbCl ₂
0.1	0.0325	"	1	0.0080	"
0.2	0.0194	"	1.5	0.0073	"
0.4	0.0138	"	2.5	0.0092	"
0.5	0.0130	"	4	0.0182	"
0.52	0.0127	" + NH ₄ Cl·2PbCl ₂	6	0.0473	"
0.55	0.0123	NH ₄ Cl·2PbCl ₂	7.29	0.0898	" + NH ₄ Cl
0.65	0.0105	"	7.29	0	NH ₄ Cl

For additional results at 25.2° see von Ende, 1901.

SOLUBILITY OF LEAD CHLORIDE IN AQUEOUS SOLUTIONS OF AMMONIUM CHLORIDE.
(Demassieux, 1923.)

Results at 17°.		Results at 50°.		Results at 100°.		Solid Phase at each temp.
Gms. per 100 gms. sat. sol.		Gms. per 100 gms. sat. sol.		Gms. per 100 gms. sat. sol.		
PbCl ₂ .	NH ₄ Cl.	PbCl ₂ .	NH ₄ Cl.	PbCl ₂ .	NH ₄ Cl.	Pb Cl ₂ .
0.89	0.0	1.09	0.50	3.10	0.0	»
0.27	0.96	0.67	1.51	2.0	1.31	»
0.14	2.40	0.50	3.85	1.75	5.47	»
0.07	4.19	0.54	4.28	1.76	6.01	»
0.08	4.31	0.58	4.45	1.78	8.62	» + 1.2
0.07	4.98	0.49	4.84	1.73	9.66	1.2
0.09	12.30	0.39	7.27	2.90	19.77	»
0.34	22.34	0.72	19.42	4.50	26.00	»
—	—	1.76	27.15	8.40	34.63	»
—	—	3.29	31.25	11.40	36.29	»
—	—	—	—	12.67	37.38	» + 1.2
—	—	—	—	12.51	37.92	1.2
—	—	—	—	10.68	38.82	»
—	—	—	—	9.53	41.90	» + NH ₄ Cl
0.64	26.49	3.96	33.55	—	—	2.1 + NH ₄ Cl
0.33	27.23	1.60	33.90	4.21	42.96	NH ₄ Cl
0.0	27.35	0.32	34.14	3.06	43.40	»
—	—	0.0	34.25	0.71	43.88	»

2.1 = 2PbCl₂.NH₄Cl; 1.2 = PbCl₂.2NH₄Cl.

SOLUBILITY OF LEAD CHLORIDE IN AQUEOUS SOLUTIONS OF AMMONIUM CHLORIDE
AT 25°. (Kendall and Sloan, 1925.)

Gm. equiv. per liter		Gm. equiv. per liter		Gm. equiv. per liter		Gm. equiv. per liter	
[NH ₄ Cl].	[PbCl ₂].	[NH ₄ Cl].	[PbCl ₂].	[NH ₄ Cl].	[PbCl ₂].	[NH ₄ Cl].	[PbCl ₂].
0.20	0.02207	1.96	0.00923	4.22	0.02220	5.46	0.03645
0.50	0.01305	2.57	0.01142	4.64	0.02620	5.66	0.04000
0.56	0.01224	3.18	0.01462	4.83	0.02836	6.00	0.04723
0.80	0.00878	3.47	0.01643	5.00	0.03030	6.28	0.05507
1.00	0.00765	3.60	0.01721	5.09	0.03142	6.30	0.05601
1.20	0.00769	3.90	0.01982	5.20	0.03264		

The solid phase at all concentrations above 0.6 n is 2 Pb Cl₂.NH₄Cl.

SOLUBILITY OF LEAD CHLORIDE IN AQUEOUS SOLUTIONS OF SODIUM BROMIDE
AT 25°. (Herz and Hellebrandt, 1923.)

Normality of Na Br.....	0.48	0.97	1.94	2.82	3.78
Mol. Pb per liter.....	0.00697	0.01210	0.05932	0.14310	0.31855

SOLUBILITY OF LEAD CHLORIDE IN AQUEOUS SOLUTIONS OF SODIUM CHLORIDE
AT 25°.

Results of Herz and Hellebrandt, 1923.		Results of Kendall and Sloan, 1923.		Results of Kendall and Sloan, 1923.	
Normality of Na Cl.	Mol. Pb per liter.	Gm. equiv. per liter		Gm. equiv. per liter.	Gm. equiv. per liter
		[Na Cl].	[Pb Cl ₂].	[Na Cl].	[Pb Cl ₂].
0.0	0.03895	0.25	0.01603	1.56	0.01468
0.51	0.00648	0.40	0.01370	1.85	0.01725
1.02	0.00631	0.50	0.01300	1.96	0.01807
2.05	0.00961	0.70	0.01192	2.25	0.02100
3.03	0.01279	0.86	0.01205	2.46	0.02370
4.10	0.04377	1.14	0.01261	2.66	0.02606
		1.46	0.01403	2.90	0.02944
					4.39
					0.06302
					4.50
					0.07009

Solid phase above 0.5 n Na Cl is Na Cl.2 Pb Cl₂.

SOLUBILITY OF LEAD CHLORIDE IN AQUEOUS SOLUTIONS OF SODIUM CHLORIDE
(Demassieux, 1922.)

Results at 13°.		Results at 50°.		Results at 100°.		Solid Phase at each temp.
Gms. per 100 gms. sat. sol.		Gms. per 100 gms. sat. sol.		Gms. per 100 gms. sat. sol.		
Na Cl.	Pb Cl ₂ .	Na Cl.	Pb Cl ₂ .	Na Cl.	Pb Cl ₂ .	
0.0	0.82	2.07	0.57	2.01	1.65	Pb Cl ₂
1.0	0.18	5.36	0.38	5.00	1.53	»
4.97	0.09	9.57	0.58	13.12	2.54	»
13.39	0.19	17.22	1.20	19.55	4.95	»
16.46	0.31	22.94	2.41	24.01	9.00	»
23.46	1.10	25.51	4.04	25.21	10.47	»
26.17	1.88	26.46	4.94	26.27	11.92	» + Na Cl
26.29	0.75	26.48	3.88	27.05	6.86	Na Cl
26.33	0.0	26.89	1.50	27.09	2.82	»

SOLUBILITY OF LEAD CHLORIDE IN AQUEOUS SOLUTIONS OF STRONTIUM BROMIDE
AT 25°. (Herz and Hellebrandt, 1923.)

Normality of $\frac{\text{Sr Br}_2}{2}$. . .	0.52	1.04	2.08	3.12	4.16
Mol. Pb per liter	0.00629	0.01139	0.04875	0.1397	0.3993

Cl

SOLUBILITY OF LEAD CHLORIDE IN AQUEOUS SOLUTIONS OF STRONTIUM CHLORIDE
AT 25°.

Results of Herz and Hellebrandt, 1923.		Results of Kendall and Sloan, 1925.					
Normality of Sr Cl ₂ .	Mol. Pb. per liter.	Gm. equiv. per liter		Gm. equiv. per liter		Gm. equiv. per liter.	
		{Sr Cl ₂ }.	{Pb Cl ₂ }.	{Sr Cl ₂ }.	{Pb Cl ₂ }.	{Sr Cl ₂ }.	{Pb Cl ₂ }.
0.51	0.00678	0.20	0.02633	1.70	0.02985	2.96	0.04304
1.02	0.00640	0.32	0.02502	2.06	0.03260	3.32	0.05032
1.38	0.00824	0.60	0.02480	2.12	0.03303	3.36	0.05118
2.66	0.01418	0.80	0.02522	2.55	0.03705	3.47	0.05440
3.09	0.01578	1.12	0.02620	2.66	0.03869	3.64	0.06009
4.13	0.02698	1.46	0.02821	2.80	0.04027	3.78	0.06502
Solid Phase Sr Cl ₂ , Pb Cl ₂ in all cases.						3.88	0.06940

EQUILIBRIUM IN THE SYSTEM LEAD CHLORIDE, LEAD IODIDE AND WATER AT 30°.
(Somery, 1927.)

Gms. per 100 cc sat. sol.		Solid Phase	Gms. per 100 cc sat. sol.		Solid Phase
PbI ₂	PbCl ₂		PbI ₂	PbCl ₂	
0.0	1.171	PbCl ₂	0.0520	0.550	PbCl ₂
0.0081	1.171	"	0.0602	0.518	" + PbI ₂
0.0168	1.171	"	0.0606	0.417	PbI ₂
0.0235	1.171	" + PbICl	0.0620	0.352	"
0.0241	1.140	PbICl	0.0647	0.209	"
0.0278	0.958	"	0.0712	0.100	"
0.0390	0.717	"	0.0788	0.046	"
0.0432	0.631	"	0.0910	0.00	"

SOLUBILITY OF LEAD CHLORIDE IN AQUEOUS SOLUTIONS OF LEAD NITRATE AT 25°. Results by Harkins, 1911.

Gms. per Liter Sat. Sol.		d_{4}^{25} of Sat. Sol.	Aq. Pb(NO ₃) ₂ Sol., Gms. per 1000 Gms. H ₂ O.	Gms. PbCl ₂ per 1000 Gms. Sat. Sol.
Pb(NO ₃) ₂ .	PbCl ₂ .			
0	10.81	1.0069	0	10.89
3.31	10.67	1.0095	3.31	10.96
8.28	10.65	1.0139	6.62	10.53
16.56	10.84	1.0210	33.12	11.15
33.12	11.57	...	82.80	12.95

Results by Armstrong and Eyrce, 1913.

SOLUBILITY OF LEAD CHLORIDE IN AQUEOUS SOLUTIONS OF ACETIC ACID AT 25°. (Hill, 1917.)

Normality of Acetic Acid.	Dissolved PbCl ₂ .		Normality of Acetic Acid.	Dissolved PbCl ₂ .	
	Gms. per Liter.	Equiv. per Liter.		Gms. per Liter.	Equiv. per Liter.
0	10.77	0.07753	0.465	10.27	0.07392
0.05	10.82	0.07782	0.929	9.45	0.06803
0.10	10.85	0.07717	1.845	7.90	0.05686
0.20	10.70	0.07703	3.680	5.26	0.03788

Cl

SOLUBILITY OF LEAD CHLORIDE IN AQUEOUS SOLUTIONS OF ACETIC ACID AT 25°. (Herz and Martin, 1924.)

Titrametric Conc. of CH ₃ COOH.	Mols. Pb per liter.	Titrametric Conc. of CH ₃ COOH.	Mols. Pb per liter.	Titrametric Conc. of CH ₃ COOH.	Mols. Pb per liter.
0.0	0.03895	5.16	0.01446	10.17	0.00363
1.02	0.03365	5.87	0.01163	11.24	0.00258
2.05	0.02796	7.06	0.00887	12.20	0.00191
3.04	0.02266	7.93	0.00660	13.28	0.00136
3.94	0.01837	8.94	0.00505	14.44	0.00123
				14.90	0.00120

SOLUBILITY OF LEAD CHLORIDE IN AQUEOUS SOLUTIONS OF ACETIC ACID AT 25°. (Sanved, 1929.)

Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase
PbCl ₂	CH ₃ COOH		PbCl ₂	CH ₃ COOH	
1.060	0.0	PbCl ₂	0.481	24.83	PbCl ₂
1.024	1.28	"	0.372	30.32	"
1.983	2.33	"	0.213	42.20	"
0.883	6.01	"	0.147	51.72	"
0.793	9.58	"	0.084	60.40	"
0.627	17.27	"	0.047	78.30	"
0.547	21.31	"	0.013	96.60	"

The author also gives results at 25° for the quaternary system PbCl₂ + Pb(CH₃COO)₂ + CH₃COOH + H₂O.

SOLUBILITY OF LEAD CHLORIDE IN AQUEOUS SOLUTIONS OF ALCOHOL AND OF MANNITOL AT 25°. (Kernot and Pomilio, 1912.)

Results for Aqueous Ethyl Alcohol. Results for Aqueous Mannitol.

Gms. per Liter Solution.		Gms. per Liter Solution.	
C ₂ H ₅ OH.	PbCl ₂ .	(CH ₂ OH) ₂ (CHOH) ₄ .	PbCl ₂ .
0	10.75	0	10.75
5.75	10.16	2.84	10.42
11.51	9.36	5.69	10.67
23.02	9.14	11.38	10.64
46.05	8.25	22.76	10.91
92.10	7.12	45.53	11.16
184.20	4.76	91.06	11.29

SOLUBILITY OF LEAD CHLORIDE IN GLYCEROL. (Presse, 1874.)

1 part glycerol + 7 parts H₂O dissolve 0.91 per cent PbCl₂.

1 part glycerol + 3 parts H₂O dissolve 1.04 per cent PbCl₂.

1 part glycerol + 1 part H₂O dissolves 1.32 per cent PbCl₂.

Pure glycerol dissolves 2 per cent PbCl₂.

SOLUBILITY OF LEAD CHLORIDE IN AQUEOUS SOLUTIONS OF SEVERAL COMPOUNDS AT 25°. (Armstrong and Eyre, 1913.)

C1

Aqueous Solution of:	Gms. Cmpd. per 1000 Gms. H ₂ O.	Gms. PbCl ₂ per 1000 Gms. Sat. Sol.	Aqueous Solution of:	Gms. Cmpd. per 1000 Gms. H ₂ O.	Gms. PbCl ₂ per 1000 Gms. Sat. Sol.
Water alone	0	10.89	Ethyl Alcohol	11.51	10.43
Glycol	15.51	10.75	Glycerol	23.01	10.98
"	62.04	10.90	Propyl Alcohol	15.01	10.08
Acetaldehyde	11.01	10.54	"	60.06	9.37
"	33.03	9.82	Methyl Acetanilide	29.82	10.25
Paraldehyde	11.01	10.50	Hydrochloric Acid	9.12	4.23
"	33.02	9.96	"	18.23	3.60

100 cc. anhydrous hydrazine dissolve 3 gms. PbCl₂ at ord. temp. with decomposition. (Welsh and Broderson, 1915.)

SOLUBILITY OF LEAD CHLORIDE IN PYRIDINE. (Heise, 1912.)

t°.	Gms. PbCl ₂ per 100 Gms. Pyridine.	Solid Phase.	t°.	Gms. PbCl ₂ per 100 Gms. Pyridine.	Solid Phase.
-20	0.303	PbCl ₂ ·2C ₅ H ₅ N	76	0.893	PbCl ₂ ·2C ₅ H ₅ N
0	0.364	"	90	1.07	"
+22	0.459	"	94	1.12	"
44	0.559	"	102	1.31	"
65	0.758	"			

100 gms. Liquid Sulfur Dioxide (SO₂) dissolve 0.019 gm. PbCl₂ at 0°. (Jander and Ruppolt, 1937.)

Fusion-point data are given for:

Cl	PbCl ₂	+ PbF ₂	(Sandonnini, 1911; Pelabon and Lande, 1928.)
	"	+ PbI ₂	(Honkemeyer, 1906; Pelabon and Lande, 1928.)
	"	+ PbO ₂	(Ruer, 1906; Baroni, 1934; Pelabon and Lande, 1928.)
	"	+ Pb ₃ (PO ₄) ₂	(Amadori, 1918; 1919.)
	"	+ Pb ₃ (VO ₄) ₂	(Amadori, 1919.)
	"	+ PbS	(Truthe, 1912.)
	"	+ AgCl	(Tubaudt and Eggert, 1920.)
	"	+ KCl	(Tries, 1914; Lorenz and Ruckstuhl, 1906.)
	"	+ NaCl	(Tries, 1914; Demassieux, 1923.)
	"	+ RbCl	(Tries, 1914.)
	"	+ SrCl ₂	(Sandonnini, 1911, 1914.)
	"	+ TiCl ₂	(Korreg, 1911; Sandonnini, 1911, 1914.)
	"	+ SnCl ₂	(Hermann, 1911; Sandonnini, 1911, 1914.)
	"	+ ZnCl ₂	(Hermann, 1911.)

LEAD FluoroCHLORIDE PbFCl.

SOLUBILITY OF LEAD FLUOROCHLORIDE IN WATER AND IN AQUEOUS SOLUTIONS.
(Stark, 1911.)

Solubility in Water.

Solubility in Aq. Solutions at 25°.

t°.	Gms. PbFCl per 100 Gms. H ₂ O.	Aq. Solution of:	Gms. PbFCl per 100 cc. Sat. Sol.	Aq. Solution of:	Gms. PbFCl per 100 cc. Sat. Sol.
0	0.0211	0.00996 n PbCl ₂	0.0030	0.0535 n HCl	0.0758
18	0.0325	0.0195 n "	0.0008	0.1060 n "	0.1006
25	0.0370	0.0392 n "	0.0005	0.0518 n CH ₃ COOH	0.0512
100	0.1081			0.1055 n "	0.0561

LEAD CHLORITE Pb(ClO₂)₂.

SOLUBILITY OF LEAD CHLORITE IN WATER.

(Levi, 1923.)

t°	Gms. Pb(ClO ₂) ₂ per 100 gms. sat. sol.	Solid Phase
0	0.035	Pb(ClO ₂) ₂
25	0.12	"
50	0.19	"
75	0.32	"
100	0.41	"

ClO LEAD CHLORATE Pb(ClO₃)₂·H₂O.

100 grams H₂O dissolve 151.3 gms. Pb(ClO₃)₂, or 100 gms. sat. solution contain 60.2 gms. Pb(ClO₃)₂ at 18°. Density of solution, 1.947. (Mylius and Funk, 1897.)

100 gms. H₂O dissolve 440 gms. Pb(ClO₃)₂ at 18°, $d_{18} = 1.63$. (Carlson, 1910.)

LEAD per CHLORATE Pb(ClO₄)₂·3H₂O.

100 gms. sat. solution of lead perchlorate trihydrate in water contain 81.472 gms. Pb(ClO₄)₂ at 25° and the density of the solution is $d_{25}^4 = 2.7753$.
(Willard and Kassner, 1926.)

100 cc Furfural dissolve 25 gms. Pb(ClO₄)₂ at about 20°.

100 cc Cellosolve (mono ethyl ether of ethylene glycol) dissolve about 105 gms. Pb(ClO₄)₂ at about 20°. (Chaney and Mann, 1931.)

LEAD Hexa Antipyrine Per CHLORATE [Pb(COC₁₀H₁₂N₂)₆](ClO₄)₂.

100 cc sat. solution of Lead Hexa antipyrine per chlorate in water contain 5.44 gms. [Pb(COC₁₀H₁₂N₂)₆](ClO₄)₂ at 20°. (Wilke-Dörfurt and Schliephake, 1929.)

LEAD CHROMATE PbCrO_4 .

SOLUBILITY OF LEAD CHROMATE IN WATER.

t°.	Mols. PbCrO_4 per Liter.	Gms. PbCrO_4 per Liter.	Method.	Authority.
18	$3.0 \cdot 10^{-7}$	0.00010	Solution equilibrium	(Beck and Stegmüller, 1910.)
..	$1.4 \cdot 10^{-7}$	0.00004	"	(Auerbach and Pick.)
18	$3.2 \cdot 10^{-7}$	0.00010	Conductivity	(Kohlrausch, 1908.)
20	$2.1 \cdot 10^{-7}$	0.00007	Radio Indicators	(v. Hevesy and Rona, 1915.)

A more recent very careful direct determination of the solubility of lead chromate in water by Huybrechts and Degard, 1933, gave 0.00017 gm. PbCrO_4 per liter at 20°. The pH of the water was 6.27.

SOLUBILITY OF LEAD CHROMATE IN AQUEOUS SOLUTIONS OF ACETIC ACID AND OF AMMONIUM ACETATE AT 20°.

(Huybrechts and Degard, 1933.)

Results for Aqueous Solutions of:

Acetic Acid		Ammonium Acetate	
Normality of Aq. CH_3COOH	Gms. PbCrO_4 per liter sat. sol.	Normality of Aq. $\text{NH}_4\text{CH}_3\text{COO}$	Gms. PbCrO_4 per liter sat. sol.
0.025	0.00130	0.05	0.00093
0.05	0.00234	0.10	0.00136
0.10	0.00429	0.20	0.00210
0.20	0.00468	0.50	0.00936
0.50	0.00616		

The solubility of Lead Chromate is greatly reduced in presence of soluble chromates. In aqueous 0.0001 normal K_2CrO_4 only 0.00006 gms. PbCrO_4 per liter was present. Results are given showing the solubility of PbCrO_4 in aqueous solutions of mixtures of acetic acid and ammonium acetate and of the reduction of the solubility of PbCrO_4 in aqueous acetic acid, ammonium acetate and of their mixtures, caused by the simultaneous presence of calcium chromate. The application of these results to the titrametric determination of lead is discussed.

SOLUBILITY OF LEAD CHROMATE IN AQUEOUS SOLUTIONS OF HYDROCHLORIC AND OF NITRIC ACIDS. (Beck and Stegmüller, 1910, 1911.)

Solubility in Aq. HCl .				Solubility in Aq. HNO_3 at 18°.	
Normality of HCl .	Milligrams Pb per 100 cc. Sat. Sol. at:			Normality of HNO_3 .	Milligrams Pb per 100 cc. Sat. Sol.
	18°.	25°.	37°.		
0.1	3.86	4.96	7.40	0.1	2.67
0.2	8.15	10.06	15.40	0.2	4.70
0.3	13.56	17.38	27.30	0.3	6.46
0.4	22.14	27.78	43.60	0.4	8.31
0.5	32.30	42.60	68	0.5	10.31
0.6	46.60	61.06	97.20	0.6	12.39

Results are also given for the solubility of mixtures of lead chromate and lead sulfate in aqueous hydrochloric acid at 25° and 37°.

SOLUBILITY OF LEAD CHROMATE IN AQUEOUS POTASSIUM HYDROXIDE SOLUTIONS. (Lacland and Lepierre, 1891.)

t°.	Grams KOH per 100 cc.	Grams PbCrO_4 per 100 cc.
15	2.308	1.19
60	2.308	1.62
80	2.308	2.61
102	2.308	3.85

LEAD CHROMATE PbCrO_4 .

SOLUBILITY OF LEAD CHROMATE IN AQUEOUS SOLUTIONS OF PERCHLORIC ACID
AND OF MIXTURES OF PERCHLORIC ACID AND LEAD PERCHLORATE
AT 25°. (Willard and Kassner, 1926.)

Solvent mols. per liter		Dissolved PbCrO_4		Solvent mols. per liter		Dissolved PbCrO_4			
HClO_4 .	PbClO_4 .	Gms. per 100 cc.	Millimols. per 100 cc.	HClO_4 .	PbClO_4 .	Gms. per 100 cc.	Millimols. per 100 cc.		
0.1	+	0.0	0.0041	0.0127	5.0	+	0.0	0.0191	0.0591
0.5	+	0.0	0.0120	0.0371	0.5	+	0.005	0.0005	0.0015
1.0	+	0.0	0.0140	0.0433	1.0	+	0.005	0.0013	0.0040
2.0	+	0.0	0.0199	0.0616	2.0	+	0.010	0.0012	0.0037
3.0	+	0.0	0.0211	0.0668	2.0	+	0.015	0.0006	0.0019
4.0	+	0.0	0.0213	0.0659	5.0	+	0.020	0.0001	0.0003

SOLUBILITY OF LEAD CHROMATE IN AQUEOUS SOLUTIONS OF NITRIC ACID
AND OF MIXTURES OF NITRIC ACID AND LEAD NITRATE AT 25°.

(Willard and Kassner, 1926.)

Mols. per liter solvent			Dissolved Pb Cr O ₄		Mols. per liter solvent			Dissolved Pb Cr O ₄	
			Gms. per 100 cc.	Millimols. per 100 cc.				Gms. per 100 cc.	Millimols. per 100 cc.
HNO ₃ .	Pb(NO ₃) ₂ .				HNO ₃ .	Pb(NO ₃) ₂ .			
0.1	+	0.0	0.0063	0.0195	0.1	+	0.005	0.0001	0.0003
0.5	+	0.0	0.0177	0.0548	0.5	+	0.005	0.0018	0.0055
1.0	+	0.0	0.0385	0.1190	1.0	+	0.010	0.0038	0.0117
2.0	+	0.0	0.0889	0.2752	3.0	+	0.020	0.0381	0.1179
3.0	+	0.0	0.1701	0.5265	2.0	+	0.15	0.0012	0.0037
4.0	+	0.0	0.2810	0.8700	2.0	+	0.25	0.0002	0.0006
5.0	+	0.0	0.4367	1.3510	2.0	+	0.3 *	0.0002	0.0006

* $\text{Na}_2\text{Cr}_2\text{O}_7$ instead of $\text{Pb}(\text{NO}_3)_2$.

The solubility of lead chromate in perchloric acid increases up to a molar concentration of the acid of about 4.0 and then begins to decrease, while in nitric acid the solubility continues to increase with increasing concentration of acid. It is also noted that lead chromate is much less soluble in perchloric than in nitric acid of the same concentration.

Fusion point data for mixtures of lead chromate and lead sulfate, lead chromate and lead molybdate, and lead chromate and lead tungstate are given by Jaeger and Germs, 1921.

LEAD FLUORIDE PbF_2 .

One liter of water dissolves 0.6 gm. PbF_2 at 9°, 0.64 gm. at 18°, and 0.68 gm. at 26.6° (conductivity method). (Kohlrausch, 1908.)

100 cc sat. solution of Lead Fluoride in water contain 0.066 gm. PbF_2 at 25° and the pH of the solution is 5.3. (Carter, 1928.)

Experiments upon the influence of the size of grain upon the solubility of Lead Fluoride in water are given by Duncan, 1923.)

100 cc. anhydrous hydrazine dissolve 6 gms. PbF_2 at room temp. with decomposition. (Welsh and Broderson, 1915.)

LEAD FLUORIDE

100 gms. liquid Sulfur Dioxide (SO_2) dissolve 0.053 gm. PbF_2 at 0° .
(Jander and Ruppolt, 1937.)

Fusion-point data are given for:

PbF_2 + PbI_2	(Sandonnini, 1911.)
" + PbO_2	(Sandonnini, 1914.)
" + $\text{Pb}_3(\text{PO}_4)_2$	(Amadori, 1912, 1918, 1919.)
" + $\text{Pb}_3(\text{VO}_4)_2$	(Amadori, 1919.)
" + NaF	(Puchin and Baskow, 1913.)

LEAD Antipyrine Boro FLUORIDE $[\text{Pb}(\text{COC}_{10}\text{H}_{12}\text{N}_2)_6](\text{BF}_4)_2$.

100 cc sat. solution of Lead Antipyrine Boro Fluoride in water contain 15.1 gm $[\text{Pb}(\text{COC}_{10}\text{H}_{12}\text{N}_2)_6](\text{BF}_4)_2$ at 20° . (Wilke-Dörfurt and Mureck, 1929.)

LEAD TriPotassium Hydrogen Octa FLUORIDE, $3\text{KF} \cdot \text{HF} \cdot \text{PbF}_4$.LEAD DiSodium Hexa FLUORIDE $2\text{NaF} \cdot \text{PbF}_4$.

Data for the solubility of these two salts in water and in aqueous solutions of H_2F_2 at 25° are given by Clark, 1919.

LEAD Phospho FLUORIDE PbPO_3F .

One liter sat. solution of Lead Phospho Fluoride in Water contain 0.0099 gm. PbPO_3F per liter. (Lang, 1929.)

LEAD Silico FLUORIDE $\text{PbSiF}_6 \cdot 4\text{H}_2\text{O}$.

SOLUBILITY OF LEAD SILICO FLUORIDE IN WATER.

(Jatlov and Pinaevskaja, 1938.)

t°	Gms. PbSiF_6 per 100 gms. sat. sol.	Solid Phase	t°	Gms. PbSiF_6 per 100 gms. sat. sol.	Solid Phase
0	65.48	$\text{PbSiF}_6 \cdot 4\text{H}_2\text{O}$	60	80.11	$\text{PbSiF}_6 \cdot 2\text{H}_2\text{O}$
20	68.97	"	65	80.75	"
20(d = 2.4314)	67.90 (1)	"	80	81.06	"
50	74.16	"	100	82.25	"
57	77.70	"			

(1) Worthington and Haring, 1931.)

EQUILIBRIUM IN THE SYSTEM LEAD SILICO FLUORIDE
SILICO FLUORIC ACID AND WATER AT 20° .

(Jatlov and Pinaevskaja, 1938.)

Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase
H_2SiF_6	PbSiF_6		H_2SiF_6	PbSiF_6	
0.0	68.97	$\text{PbSiF}_6 \cdot 4\text{H}_2\text{O}$	13.93	43.10	$\text{PbSiF}_6 \cdot 4\text{H}_2\text{O}$
0.98	67.96	"	25.82	23.95	"
7.34	56.50	"	39.65	10.38	"

SOLUBILITY OF TRIMETHYL, TRIETHYL, ETC. LEAD FLUORIDES IN SEVERAL SOLVENTS.
(Krause and Pohland, 1922.)

Compound.	Formula.	t°.	Gms. compd. per 100 gms. of			
			H ₂ O.	CH ₃ OH.	C ₂ H ₅ OH.	C ₆ H ₆ .
Tri methyl lead fluoride...	(CH ₃) ₃ PbF	30	5.51	8.24	6.89	0.028
" " " "	"	50	26.3	99.5	82.0	0.87
Tri ethyl " " "	(C ₂ H ₅) ₃ PbF	30	1.3	7.24	6.11	0.185
" " " "	"	50	7.04	90.0	75.1	0.60
Tri n propyl " " "	(n C ₃ H ₇) ₃ PbF	30. I	0.17	2.01	1.21	0.055
Tri iso butyl " " "	"	50	0.23	4.94	3.53	0.082
Tri iso butyl " " "	(i C ₄ H ₉) ₃ PbF	30	0.12	1.76	1.09	0.042
" " " "	"	50	0.18	2.96	2.13	0.071
Tri iso amyl " " "	"	30. I	0.019	2.34	1.73	0.063
" " " "	(i C ₅ H ₁₁) ₃ PbF	30	0.031	0.36	0.15	0.080
Tri phenyl " " "	"	50	0.022	6.32	4.55	0.004
" " " "	"	30	0.031	0.36	0.15	0.080
Tri cyclo hexyl " " "	"	50	0.10	1.45	0.24	0.092
" " " "	(C ₆ H ₁₁) ₃ PbF	30	0.096	0.66	0.39	0.11

LEAD SUB IODIDE Pb I.

1000 cc. sat. solution of lead sub iodide in water contain 0.35 milliequivalents Pb I at 25° as determined by the conductivity method. (Denham, 1918.)

LEAD IODIDE PbI₂.

SOLUBILITY IN WATER.
(Lichty, 1903.)

t°.	Density. (H ₂ O at 0°.)	Grams PbI ₂ per 100.		Millimols PbI ₂ per 100.	
		cc. Solution.	Grams H ₂ O.	cc. Solution.	Grams H ₂ O
0	1.0006	0.0442	0.0442	0.096	0.096
15	0.9998	0.0613	0.0613	0.133	0.133
25	0.9980	0.0762	0.0764	0.165	0.166
35	0.9951	0.1035	0.1042	0.224	0.226
45	0.9915	0.1440	0.1453	0.312	0.315
55	0.9872	0.1726	0.1755	0.374	0.381
65	0.9827	0.2140	0.2183	0.464	0.473
80	0.9745	0.2937	0.3023	0.637	0.656
95	0.9671	0.3814	0.3960	0.828	0.859
100	...	0.420	0.436	0.895	0.927

Data for the solubility of lead iodide in water by the conductivity method are given by Böttger, 1903; Kohlrausch, 1904-05; Denham, 1917.

Later determinations of the Solubility of Lead Iodide in Water are as follows.

t°	Gms. PbI ₂ per 100 gms. sat. sol.	Authority
13	0.05	Demassieux, 1923
20	0.06	" "
25	0.076	Burrage, 1926
30	0.09	Sowerby, 1927
50	0.17	Demassieux, 1923

SOLUBILITY OF LEAD IODIDE IN WATER AT TEMPERATURES ABOVE 100°.
(Benrath, Quedabo, Schiffers and Wunderlich, 1937.)

t°	Gms. PbI ₂ per 100 gms. sat. sol.	Solid Phase	t°	Gms. PbI ₂ per 100 gms. sat. sol.	Solid Phase
175	1.42	PbI ₂	291	8.43	PbI ₂
234	3.65	"	334	12.0 - 82	" + solution + melt
280	6.37	"	338	87.5	"
281	6.44	"	360	95.3	"

SOLUBILITY OF LEAD IODIDE IN AQUEOUS SOLUTIONS OF SODIUM CHLORIDE AT 25°
(Burrage, 1926.)

Gms. per 100 gms. sat. sol.		Solid Phase.	Gms. per 100 gms. sat. sol.		Solid Phase.
Na Cl.	Pb I ₂ .		Na Cl.	Pb I ₂ .	
0.00	0.0758	Pb I ₂	0.234	0.110	Pb I ₂
0.029	0.0778	"	0.586	0.141	"
0.059	0.0859	"	1.170	0.164	"
0.116	0.0951	"	2.980	0.179	"

SOLUBILITY OF MIXTURES OF LEAD IODIDE AND POTASSIUM IODIDE IN WATER.
(Ditte, 1881; Schreinemakers, 1892.)

t°.	Gms. per 1000 Gms. H ₂ O.		Solid Phase.	t°.	Gms. per 1000 Gms. H ₂ O.		Solid Phase.
	PbI ₂ .	KI.			PbI ₂ .	KI.	
5	...	163	Double Salt + PbI ₂	50	526.7	1906	Double Salt + KI
20	9	260	"	64	789.3	2161	"
28	25	325	"	83.5	1,108.6	2434	"
39	45	449	"	92	1,273	2566	"
67	255	751	"	137	2,382	3278	"
80	731	1186	"	165	4,187	4227	"
80	569.9	976.4	"	218	10,303	...	"
104.5	1411	1521	"	241	12,803	7998	"
120	2151	1812	"	242	12,749	...	"
137	2874	2097	"	250	15,264	...	"
175	5603	2947	"	157	5,218	gms. PbI ₂ + KI	PbI ₂ ·2KI·2H ₂ O
189	...	3339	"	172	6,489	"	"
9	96.6	1352	" + KI	186	7,903	"	"
13	114.3	1384	"	194	9,266	"	"
23	186.3	1510	"	201	11,320	"	"

Ordinary solubility method used for temperatures below boiling-point of the solution and sealed tube (with constriction in middle) method used for temperatures above boiling point.

One liter sat. aqueous solution of iodine dissolves 0.00216 gm. mols. PbI₂ (0.996 gms.) at 20°.

(Fedotieff, 1911-12.)

SOLUBILITY OF LEAD IODIDE IN AQUEOUS SOLUTIONS OF AMMONIUM IODIDE.
(Demassieux, 1923.)

Results at 20°.			Results at 50°.		
Gms. per 100 gms. sat. sol.		Solid Phase.	Gms. per 100 gms. sat. sol.		Solid Phase.
NH ₄ I.	PbI ₂ .		NH ₄ I.	PbI ₂ .	
3.54	0.029	PbI ₂	6.13	0.14	PbI ₂
6.06	0.03	"	9.91	0.15	"
7.02	0.10	" + PbI ₂ ·NH ₄ I·2H ₂ O	13.47	0.29	" + PbI ₂ ·NH ₄ I·2H ₂ O
14.50	0.20	PbI ₂ ·NH ₄ I·2H ₂ O	18.07	0.34	PbI ₂ ·NH ₄ I·2H ₂ O
33.34	0.30	"	24.08	0.50	"
45.80	0.92	"	45.87	3.49	"
51.66	1.63	"	54.79	8.51	"
56.71	2.96	"	61.35	16.06	" + NH ₄ I
61.10	4.90	" + NH ₄ I	61.95	9.88	NH ₄ I
61.50	2.10	NH ₄ I	63.98	6.24	"
61.72	0.0	"	66.46	0.0	"

Pb PLUMBUM

1400

SOLUBILITY OF LEAD IODIDE IN ACETONE, ANILINE AND AMYL ALCOHOL. (von Laszczynski, 1894.)

Solvent.	t°.	Gms. PbI ₂ per 100 Gms. Solvent.
(CH ₃) ₂ CO	59	0.02
C ₆ H ₅ NH ₂	13	0.50
C ₆ H ₅ NH ₂	184	1.10
C ₅ H ₇ OH	133.5	0.02

SOLUBILITY OF LEAD IODIDE IN PYRIDINE.

(Heise, 1912.)

t°.	Gms. PbI ₂ per 100 Gms. Pyridine.	Solid Phase.	t°.	Gms. PbI ₂ per 100 Gms. Pyridine.	Solid Phase.
I -43.5 f. pt.	...	PbI ₂ ·3C ₅ H ₅ N	35	0.188	PbI ₂ ·2C ₅ H ₅ N
-37	0.166	"	57	0.190	"
-20	0.175	"	77	0.228	"
-9	0.186	"	92	0.290	"
0	0.200	"	98	0.340	"
+3	0.215	"	105	0.370	"
6 tr. pt.	0.225	PbI ₂ ·3C ₅ H ₅ N + PbI ₂ ·2C ₅ H ₅ N	108	0.410	"
15	0.208	PbI ₂ ·2C ₅ H ₅ N	112	0.445	"

100 gms. 95% formic acid dissolve 0.25 gm. PbI₂ at 19.8°. (Aschan, 1913.)
100 cc. anhydrous hydrazine dissolve 2 gms. PbI₂ at room temp. with decomposition. (Welsh and Broderon, 1915.)

100 gms. liquid Sulfur Dioxide (SO₂) dissolve 0.009 gm. PbI₂ at 0°. (Jander and Ruppolt, 1937.)

Fusion-point data are given for:

PbI₂ + AgI (Matthes, 1911; Tubaudt and Eggert, 1920.)
" + PbO (Baroni, 1934; Van Klooster and Owens, 1935.)

LEAD IODATE Pb(IO₃)₂.

One liter of water dissolves 0.0134 gm. Pb(IO₃)₂ at 9.2°, 0.019 gm. at 18° and 0.023 gm. at 25.8°. (Kohlrausch, 1908; Böttger, 1903.)

One liter H₂O dissolves 0.0307 gm. Pb(IO₃)₂ at 25°. (Harkins and Winninghoff, 1911.)

SOLUBILITY OF LEAD IODATE IN AQUEOUS SALT SOLUTIONS AT 25°. (H. and W., 1911.)

Gms. per Liter.		Gms. per Liter.		Gms. per Liter.	
KNO ₃ .	Pb(IO ₃) ₂ .	KIO ₃ .	Pb(IO ₃) ₂ .	Pb(NO ₃) ₂ .	Pb(IO ₃) ₂ .
0.202	0.0318	0.0113	0.0199	1.656	0.0052
1.011	0.0363	0.0227	0.0122	16.561	0.0045
5.055	0.0567	Pb(NO ₃) ₂ .		82.805	0.0078
20.220	0.0708	0.0165	0.0242	496.83	0.0418
		0.165	0.0115		

SOLUBILITY OF LEAD IODATE IN AQUEOUS SALT SOLUTIONS AT 25°. (LaMer and Goldman, 1930.)

Aqueous Solvent	Gm. Mols. Pb(IO ₃) ₂ per liter
Water alone	0.0000361
0.1 normal NaNO ₃	0.0000699
0.1 " KNO ₃	0.0000694
0.1 " KCl	0.0000829
0.1 " NaCl	0.0000830

LEAD MOLYBDATE Pb Mo O_4 .

SOLUBILITY OF LEAD MOLYBDATE IN AQUEOUS SOLUTIONS OF PERCHLORIC ACID AND OF MIXTURES OF PERCHLORIC ACID AND SALTS AT 25°.

(Willard and Kassner, 1930a)

Composition of solvent in mols. per liter.		Dissolved Pb Mo O_4 .	
		Gms. per 100 cc.	Millimols. per 100 cc.
0.01 mol. HClO_4		0.0016	0.0043
0.5 " "		0.0136	0.0370
1.0 " "		0.0373	0.1016
2.0 " "		0.1176	0.3204
3.0 " "		0.2436	0.6639
0.01 " " + 0.01 mol. $\text{Pb}(\text{ClO}_4)_2$		0.0002	0.0005
0.5 " " + 0.01 " "		0.0005	0.0013
0.5 " " + 0.05 " "		0.0004	0.0011
0.5 " " + 0.10 " "		0.00006 (1)	0.0001 (1)
0.5 " " + 0.20 " "		0.00004 (1)	0.0001 (1)
0.5 " " + 0.02 " Na_2MoO_4		0.0004 (2)	0.0011 (2)
0.5 " " + 0.05 " "		0.00027 (2)	0.0007 (2)

Above 3.0 mol. HClO_4 , Pb Mo O_4 decomposes to form solid Mo O_3 .

MoO

SOLUBILITY OF LEAD MOLYBDATE IN AQUEOUS SOLUTIONS OF NITRIC ACID AND OF MIXTURES OF NITRIC ACID AND SALTS AT 25°.

(Willard and Kassner, 1930a)

Composition of solvent in mols. per liter.		Dissolved Pb Mo O_4 .	
		Gms. per 100 cc.	Millimols. per 100 cc.
0.1 mol. HNO_3		0.0020	0.0060
0.5 " "		0.0244	0.0665
1.0 " "		0.1086	0.2958
0.5 " " + 0.1 mol. $\text{Pb}(\text{NO}_3)_2$		0.00032 (1)	0.0009 (1)
0.5 " " + 0.2 " "		0.0002 (1)	0.0005 (1)
0.5 " " + 0.02 " Na_2MoO_4		0.00064 (2)	0.0017 (2)
0.5 " " + 0.05 " "		0.0007 (2)	0.0019 (2)

Above 1.0 mol. HNO_3 , Pb Mo O_4 decomposes to form solid Mo O_3 .

(1) Molybdenum determined colorimetrically. (2) Lead determined colorimetrically.

Fusion-point data for mixtures of Pb Mo O_4 + Pb SO_4 are given by Germs, 1907, and Jaeger and Germs, 1921.

LEAD NITRATE $\text{Pb}(\text{NO}_3)_2$.

NO

SOLUBILITY IN WATER.

(Mulder; Kremers, 1854; at 15°, Michel and Kraft, 1854; at 17°, Euler, 1904.)

t°.	Grams $\text{Pb}(\text{NO}_3)_2$ per 100 Gms.			t°.	Grams $\text{Pb}(\text{NO}_3)_2$ per 100 Gms.		
	Water.		Solution.		Water.		Solution.
0	36.5 ⁽¹⁾	38.8 ⁽²⁾	27.33 ⁽³⁾	40	69.4	75	41.9
10	44.4	48.3	31.6	50	78.7	85	45
17	50	54	34.2	60	88	95	47.8
20	52.3	56.5	35.2	80	107.6	115	52.7
25	56.4	60.6	36.9	100	127	138.8	57.1
30	60.7	66	38.8	17	52.76*		34.54*

* Euler.

(1) Mulder, (2) Kremers, (3) Average of M and K.

Density of saturated solution at 17° = 1.405.

(Euler.)

100 gms. H_2O dissolve 55.8 gms. $\text{Pb}(\text{NO}_3)_2$ at 20°.

(LeBlanc and Noyes, 1890.)

100 gms. H_2O sat. with $\text{Pb}(\text{NO}_3)_2$ + KNO_3 at 20° dissolve 95.39 gms. $\text{Pb}(\text{NO}_3)_2$.

(LeBlanc and Noyes, 1890.)

+61.05 gms. KNO_3 .100 gms. H_2O sat. with $\text{Pb}(\text{NO}_3)_2$ + NaNO_3 at 20° dissolve 38.42 gms. $\text{Pb}(\text{NO}_3)_2$.

(LeBlanc and Noyes, 1890.)

+84.59 gms. NaNO_3 .

SOLUBILITY OF LEAD NITRATE IN AQUEOUS SOLUTIONS OF COPPER NITRATE
AT 20°.
Fedotieff, 1911-12.)

Gms. per 100 Gms. H ₂ O.		<i>d</i> ₂₀ of Sat. Sol.	Gms. per 100 Gms. H ₂ O.		<i>d</i> ₂₀ of Sat. Sol.
Cu(NO ₃) ₂ .	Pb(NO ₃) ₂ .		Cu(NO ₃) ₂ .	Pb(NO ₃) ₂ .	
0	55.11	1.419	37.96	13.08	1.360
7.7	39.34	1.354	60.32	8.19	1.451
15.04	27.80	1.322	83.11	5.37	1.546
24.63	19.05	1.321	100.29	3.53	1.622
33.25	14.70	1.343	127.70*	2.33*	1.700

* Solid phase in contact with this solution = Pb(NO₃)₂ + Cu(NO₃)₂.6H₂O.

SOLUBILITIES OF THE NITRATES OF LEAD ISOTOPES IN WATER AT 25°02.
(Richards and Schumb, 1918.)

The two samples of nitrate were prepared, one from salt made from « test lead » free from silver and tin, and the other from pure Australian uranio-lead nitrate. Saturation was approached from above and below the selected temperature, by constant rotation of a large excess of the solid with distilled water. Saturation was reached with extreme slowness. At least 24 hours were required. Weighed portions of the saturated solution were evaporated with H₂ SO₄ and the lead sulfate weighed after heating to constant weight at 350°.

NO

Sample of Lead Nitrate from :	Gms. Pb(NO ₃) ₂ per 100 gms.	
	Sat. sol.	Water.
Common Lead.....	37.342	59.597
Uranio Lead.....	37.280	59.439
Difference.....	0.062	0.158

An experiment similar to the above is reported by Fajans, Fischler and Lambert, 1916. These authors prepared very pure nitrate from ordinary commercial lead of at. wt. 207.15 and from lead prepared from Colorado carnotite, and having an at. wt. of 206.59. Saturation was approached from above and below by constant agitation for at least two days at 24°43. Very accurate specific gravity determinations of the saturated solutions were also made. The determination of the lead was made as sulfate.

Sample of Lead Nitrate from :	<i>d</i> _{21.45} of sat. sol.	PbSO ₄ found in 3.0445 cc. of sat. sol.		Mol. Solubility.
Ordinary Lead.....	1.444499 ± 0.000013	1.4693	=	0.004855
Carnotite.....	1.443587 ± 0.000016	1.4740	=	0.004861
Joachimsthaler Pechblend.	1.443586 ± 0.0000015			
Difference.....				0.000006

The authors conclude from the density experiment that a difference exists in the sp. gr. of the saturated solutions of the nitrates of lead isotopes which is slightly greater than that calculated. The difference in the molecular solubility is less than 1 %, while the difference in atomic weight is 2.7 %.

EQUILIBRIUM IN THE SYSTEM LEAD NITRATE, SODIUM NITRATE AND WATER (Glasstone and Saunders, 1923)

Results at 0°.		Results at 25°.		Results at 50°.		Solid Phase at each temp.
Gms. per 100 gms. sat. sol.		Gms. per 100 gms. sat. sol.		Gms. per 100 gms. sat. sol.		
NaNO ₃ .	Pb(NO ₃) ₂ .	NaNO ₃ .	Pb(NO ₃) ₂ .	NaNO ₃ .	Pb(NO ₃) ₂ .	
0.0	28.70	6.02	30.89	0.0	44.79	Pb(NO ₃) ₂
2.91	25.80	10.04	27.86	4.32	40.27	"
Results at 100°.		20.94	22.33	8.75	33.77	"
0.00	55.65	30.08	18.99	17.55	29.22	"
4.24	50.78	36.43	16.86	29.87	22.88	"
		40.32	15.47	43.84	17.25	" + NaNO ₃
		41.32	13.17	47.09	11.35	NaNO ₃
		45.71	4.30	49.80	6.35	"
		47.86	0.00	53.29	0.00	"

100 gms. pyridine dissolve 4.39 gms. Pb(NO₃)₂ at 0° and 5.46 gms. at 25°.

(Muller, R., 1924.)

SOLUBILITY OF LEAD NITRATE IN CONCENTRATED AQUEOUS SOLUTIONS OF SODIUM NITRATE AND VICE VERSA, DETERMINED BY SYNTHETIC METHOD. (Isaac, 1908.)

(The several mixtures were enclosed in sealed tubes and heated until only one or two very small crystals remained undissolved. The temperature was then determined at which the edges of these crystals just showed a change from sharp to round or vice versa.)

Results for Lead Nitrate as Solid Phase.

t° of Saturation.	Gms. per 100 Gms. Sat. Sol.	
	NaNO ₃ .	Pb(NO ₃) ₂ .
32	34.42	19.09
35.5	34.15	20.33
39.5	33.71	21.35
44	33.35	22.19
49.1	32.94	23.15
55	32.60	23.93
58	32.47	24.24
62	32.33	24.57
65	32.19	24.89

Results for Sodium Nitrate as Solid Phase.

t° of Saturation.	Gms. per 100 Gms. Sat. Sol.	
	NaNO ₃ .	Pb(NO ₃) ₂ .
21	40.97	13.62
26.5	42.04	13.38
31	43.18	12.88
38.8	44.03	12.78
41	45.11	12.94
44.25	46.03	12.45
51	47.28	12.50
58	49.03	11.76
64	49.92	11.56

NO

SOLUBILITY OF MIXED CRYSTALS OF LEAD NITRATE AND STRONTIUM NITRATE IN WATER AT 25°. (Fock, 1897.)

Mol. per cent in Solution.		Gms. per 100 cc. Solution.		Sp. Gr. of Solutions.	Mol. per cent in Solid Phase.	
Pb(NO ₃) ₂ .	Sr(NO ₃) ₂ .	Pb(NO ₃) ₂ .	Sr(NO ₃) ₂ .		Pb(NO ₃) ₂ .	Sr(NO ₃) ₂ .
100	0	46.31	0	1.4472	100	0
87.41	12.39	50.47	4.56	1.4330	99.05	0.95
78.68	21.32	53.92	8.14	1.4288	98.11	1.89
56.39	43.61	45.34	17.81	1.4263	97.02	2.98
60.29	39.71	44.48	18.74	1.4245	96.06	3.94
33.70	66.30	25.23	35.03	1.4468	83.84	16.16
24.58	75.42	19.13	37.54	1.4867	32.88	67.12
0	100	0	71.04	1.5141	0	100

SOLUBILITY OF LEAD NITRATE-NITRITE, Pb(NO₃)₂·Pb(NO₂)₂·2Pb(OH)₂·2H₂O, IN AQUEOUS SOLUTIONS OF ACETIC ACID AT 13.3°. (Chilesotti, 1908.)

Normality of Acetic Acid	Gms. PbO per 100 cc. Sat. Sol.	Normality of Acetic Acid.	Gms. PbO per 100 cc. Sat. Sol.
0	0.601	0.25	5.450
0.05	1.323	0.50	9.690
0.10	2.185	0.75	15.874

SOLUBILITY OF LEAD NITRATE IN AQUEOUS SOLUTIONS OF
METHYL ALCOHOL AT 25°.
(Akerlof and Turck, 1935.)

Wt. Percent CH_3OH in solvent	Gm. Mols. $\text{Pb}(\text{NO}_3)_2$ per 1000 gms. sat. sol.	Wt. Percent CH_3OH in solvent	Gm. Mols. $\text{Pb}(\text{NO}_3)_2$ per 1000 gms. sat. sol.
0.0	1.799	60.0	0.2800
20.08	0.8768	70.0	0.1905
30.0	0.6730	80.1	0.1237
40.0	0.5151	90.02	0.0752
50.05	0.3820	100.00	0.0423

SOLUBILITY OF LEAD NITRATE IN ETHYL AND METHYL ALCOHOL.

Solvent.	Gms. $\text{Pb}(\text{NO}_3)_2$ per 100 Gms. Solvent at:				
	4°.	8°.	22°.	40°.	50°.
Aq. $\text{C}_2\text{H}_5\text{OH}$ (Sp. Gr. 0.9282)	4.96	5.82	8.77	12.8	14.9 (G)
Abs. $\text{C}_2\text{H}_5\text{OH}$	...	...	0.04 (20.5°)	...	... (de B)
Abs. CH_3OH}	...	...	1.37	...	...

(Gerardin, 1865; de Bruyn, 1892.)

100 cc. anhydrous hydrazine dissolve 52 gms. lead nitrate at room temperature with formation of a yellow precipitate. (Welsh and Broderson, 1915.)

SOLUBILITY OF LEAD NITRATE IN PYRIDINE.
(Walton and Judd, 1911.)

t°.	Gms. $\text{Pb}(\text{NO}_3)_2$ per 100 Gms. Pyridine.	Solid Phase.	t°.	Gms. $\text{Pb}(\text{NO}_3)_2$ per 100 Gms. Pyridine.	Solid Phase.
-19.4	2.93	$\text{Pb}(\text{NO}_3)_{2-4}\text{C}_5\text{H}_5\text{N}$	45	22.03	$\text{Pb}(\text{NO}_3)_{2-4}\text{C}_5\text{H}_5\text{N}$
-14.5	2.14	"	49.97	29.37	"
-10	1.90	"	51 tr. pt.	...	" + $\text{Pb}(\text{NO}_3)_{2-3}\text{C}_5\text{H}_5\text{N}$
0	3.54	"	59.52	36.70	$\text{Pb}(\text{NO}_3)_{2-3}\text{C}_5\text{H}_5\text{N}$
5.4	3.93	"	70	47.29	"
8.7	5.39	"	80	61.60	"
14.72	6.13	"	89.93	90.21	"
19.97	6.78	"	94.94	128.06	"
24.75	8.56	"	96 tr. pt.	...	" + $3\text{Pb}(\text{NO}_3)_{2-2}\text{C}_5\text{H}_5\text{N}$
30.03	10.98	"	99.89	143.36	$3\text{Pb}(\text{NO}_3)_{2-2}\text{C}_5\text{H}_5\text{N}$
34.97	13.20	"	104.90	152	"
40.03	16.94	"	109.90	163.80	"

Fusion-point data are given for mixtures of $\text{Pb}(\text{NO}_3)_2$ + TiNO_3 by Glass, Laybourne and Madgin, 1932.)

EQUILIBRIUM IN THE SYSTEM LEAD OXIDE, NITROGEN PENTOXIDE AND WATER.
(Denham and Kidson, 1931.)

d. of sat. sol.	Gms. per 100 gms. sat. solution		Solid Phase	d. of sat. sol.	Gms. per 100 gms. sat. solution		Solid Phase
	N_2O_5	PbO			N_2O_5	PbO	
Results at 25°				Results at 50°			
1.022	0.71	2.09	2.1.2½	1.022	0.60	2.69	2.1.2½
1.134	4.67	9.77	"	1.117	4.39	8.99	"
1.223	7.68	15.03	"	1.229	7.24	15.81	"
1.287	8.80	18.39	"	1.322	9.55	20.47	"
1.452	12.27	26.38	" + $\text{Pb}(\text{NO}_3)_2$	1.436	11.60	25.45	"
1.408	11.54	23.61	$\text{Pb}(\text{NO}_3)_2$	1.590	14.47	31.00	" + $\text{Pb}(\text{NO}_3)_2$
1.328	11.83	18.88	"	1.511	14.22	26.05	$\text{Pb}(\text{NO}_3)_2$
1.257	12.06	14.09	"	1.420	14.33	23.42	"
1.194	14.30	8.16	"	1.357	14.22	19.77	"
1.192	14.60	7.40	"	1.279	15.08	15.64	"
1.236	30.59	1.59	"	1.234	17.92	10.08	"
1.243	30.70	1.88	"	1.211	23.75	4.27	"
1.290	40.05	0.49	"	1.244	32.32	1.74	"
				1.308	45.33	0.04	"

2.1.2½ = $2\text{PbO} \cdot \text{N}_2\text{O}_5 \cdot 2\frac{1}{2}\text{H}_2\text{O}$.

LEAD HYDROXIDE $\text{Pb}(\text{OH})_2$.

SOLUBILITY OF LEAD HYDROXIDE IN AQUEOUS SOLUTIONS OF SODIUM HYDROXIDE.
(Moist Lead Hydroxide used, temperature not given.)
(Rubenbauer, 1902.)

Amount of Na in 20 cc.	Amt. of Pb in 20 cc.	Mol. Dilution of NaOH.	Grams per 100 cc. Solution.	
			NaOH.	$\text{Pb}(\text{OH})_2$.
0.2024	0.1012	2.27	1.759	0.590
0.3196	0.1736	1.44	2.778	1.010
0.5866	0.3532	0.785	5.10	2.056
0.9476	0.4071	0.485	8.235	2.370
1.7802	0.5170	0.258	15.470	3.010

LEAD OXIDES.**SOLUBILITY IN WATER.**

(Böttger; Ruer — Z. anorg. Chem. 50, 273, '06.)

No.	Description of Oxide.	Gm. Equiv. per Liter.	Gms. per Liter.
1.	Yellow Oxide, by boiling Pb hydroxide with 10% NaOH	1.03×10^{-4}	0.023
2.	Red Oxide, by boiling Pb hydroxide with conc. NaOH	0.56×10^{-4}	0.012
3.	Yellow Oxide, by heating No. 1 to 630°	1.05×10^{-4}	0.023
4.	Yellow Oxide, by heating No. 2 to 740°	1.00×10^{-4}	0.022
5.	Yellow Oxide, by heating com. yellow brown oxide to 620°	1.09×10^{-4}	0.024
6.	Yellow Brown Oxide commercially pure	1.10×10^{-4}	0.024
7.	Yellow Brown Oxide, by long rubbing of No. 5.	1.12×10^{-4}	0.025

Böttger gives for three samples of lead oxide, 0.017, 0.021, and 0.013 gm. per liter respectively.

One liter H_2O dissolves 0.068 gm. PbO at 18° , solid phase PbO and 0.1005 gm. PbO at 18° , solid phase $\text{Pb}_3\text{O}_4(\text{OH})_2$. (Pleissner, 1907.)

Results for the solubility of hydrated lead oxide in water and dilute H_2SO_4 solutions are given by Sehna (1909). The results are considerably higher than the above, viz. 0.1385 gm. Pb per 1000 cc. H_2O at 20° ; with increase of H_2SO_4 the solubility decreases rapidly.

100 cc. anhydrous hydrazine dissolve 1 gm. lead oxide (red) at room temp.

(Welsh and Broderson, 1915.)

SOLUBILITY OF LEAD OXIDE (PbO) IN WATER.

(Remy and Kuhlmann, 1924; Remy, 1925.)

Millimols. PbO per liter at 18° .	Milligrams. PbO per liter at 20° .	Method.
0.055	12.34	Calc. from electrolytic conductivity.
0.055	12.39	Conducto titrametric determination of used amt. of acid for saturation.

The **SOLUBILITY PRODUCT** of red lead monoxide in water at 25° is 1.17×10^{-15} and the solubility is 0.26×10^{-3} gm. mol. per liter (Glasstone, 1921). The author states that this rough comparison emphasizes the uncertainty of the ionization of lead monoxide in water and the futility of determining the solubility of lead monoxide or hydroxide in water by the conductivity method.

SOLUBILITY OF DIFFERENT FORMS OF LEAD HYDROXIDE IN AQUEOUS NORMAL SOLUTIONS OF SODIUM HYDROXIDE.

Form of PbO used.	Manner of attaining saturation.	t°.	Gm. mol. PbO per liter sat. sol.	Authority.
Ordinary	Gentle shaking (14 days).	20	0.045 (aver of 8 det.)	Glasstone, 1921
"	Vigorous shaking (14 d.).	20	0.047 (" ")	"
Reddish-brown-yellow	Stirring gently with air bubbles.	20	0.039	"
Red	"	20	0.035	"
Yellow	"	20	0.0237*	} Appleby and Reid, 1922
Red	"	20	0.0140*	

*Mean values obtained after stirring with slow stream of air up to 5 months. According to Glasstone the differences are explainable on the grounds of the varying size of the particles. Appleby and Reid consider that the results indicate that the yellow and red forms are polymorphic modifications of lead monoxide.

SOLUBILITY OF HYDRATED LEAD MONOXIDE AT 25° IN AQUEOUS SOLUTIONS OF :
(Glasstone, 1922.)

Sodium Hydroxide

Normality of Aq. NaOH.	Gm. mols. per liter sat. sol.		
	PbO. \cdot xH ₂ O.	Na plumbite.	Residual NaOH.
0.0499	0.00392	0.00347	0.0464
0.1177	0.00881	0.00836	0.1093
0.2496	0.0178	0.01735	0.2323
0.4993	0.0345	0.03405	0.4653
0.7489	0.0484	0.04795	0.7010
0.9985	0.0620	0.06155	0.9370

Potassium Hydroxide.

Normality of Aq. KOH.	Gm. mols. PbO. \cdot xH ₂ O per liter sat. sol.
0.1177	0.00892
0.9985	0.0631

The above repetition of Herz, 1901, experiments fail to confirm his results. Pleissner's (1907) hydrated oxide was used.

Results similar to the above for the solubility of the several polymorphic forms of lead oxide in aqueous NaOH solutions up to 20 normal and at both 20° and 84° are given by Applebey and Powell, 1931. The black modification was shown to owe its color to metallic lead.

More recent very careful determinations of the solubility of lead oxides in water and in aqueous solutions of sodium hydroxide at 25°, are given by Garrett, Vellenger and Fontana, 1939. The numerous determinations as plotted by the authors show that most of those made with red lead oxide fall in one curve and the determinations made with yellow, white, and black lead oxide fall more or less close to another curve. The approximate values read from these curves are as follows.

Gm. Mols. per 1000 gms. H ₂ O			Gm. Mols. per 1000 gms. H ₂ O		
NaOH	Red PbO	yellow, white and black PbO	NaOH	Red PbO	yellow, white and black PbO
0.000	0.000226	0.000477	0.004	0.00022	0.0004
0.0005	0.0001	0.0003	0.005	0.00027	0.0005
0.0010	0.0001	0.00022	0.006	0.00032	0.00057
0.002	0.00013	0.00026	0.008	0.0004	0.0007
0.003	0.00017	0.00036	0.010	0.0005	0.00085

The data were used by the authors for various theoretical calculations.

SOLUBILITY OF LEAD SESQUIOXIDE (Pb₂O₃) IN AQUEOUS SODIUM HYDROXIDE SOLUTIONS. (Glasstone, 1922 a.)

Solution of plumbite, plumbate and dilute alkali or water were mixed in various proportions and kept 4 or 5 weeks at room temperature. The supernatant solution above the precipitated sesquioxide was removed and analyzed. Equilibrium was reached very slowly.

Gram mols. per liter sat. sol.			
Na OH.	Plumbite $\times 10^3$.	Plumbate $\times 10^3$.	$\frac{[\text{HPbO}_2]}{[\text{OH}]^2} [\text{PbO}_3] \times 10^6$.
1.20	8.75	0.412	2.09
1.26	12.12	0.35	2.08
1.79	1.60	11.50	3.20
2.41	20.0	1.20	1.72
2.63	21.5	2.65	3.12

Data for the equilibrium in the system lead oxide + lead hydroxide + plumbite + Na OH + H₂O are given by Erich Muller, 1924 a.

Fusion-point data are given for:

PbO + MoO ₃	(Jaeger and Germs, 1921.)
" + SO ₃	" "
" + WO ₃	" "
" + P ₂ O ₅	(Amadori, 1916-17.)
" + V ₂ O ₅	" "
" + Pb ₃ (PO ₄) ₂	(Amadori, 1914.)
" + Pb ₃ (VO ₄) ₂	" "
" + PbSO ₄	(Schenck and Albers, 1919; Shenck and Rossbach, 1908.)
" + SiO ₂	(Weiller, 1911; Cooper, Shaw and Loomis, 1909; Geller, Creamer and Bunting, 1934.)

LEAD PeroXIDE PbO₂.

The two forms of lead superoxide, (a) amorphous and (b) crystalline, differ in their solubilities in sulphuric acid. One liter of very concentrated H₂SO₄ dissolves about 0.010 mol. PbO₂ (b) at 22°. One liter of conc. H₂SO₄ containing 1720 gms. per liter, dissolves 0.0995 mol. PbO₂ (a) at 22°. The solid phase is slowly converted to Pb(SO₄)₂. One liter of H₂SO₄ containing 1097 gms. H₂SO₄ per liter dissolves 0.004 mol. PbO₂ at 22°. The solid phase is converted more quickly to Pb(SO₄)₂. In more dilute H₂SO₄ solutions no solubility can be detected. (Dolezalek and Finckli, 1906.)

LEAD PHOSPHATE (Ortho) Pb₃(PO₄)₂.

One liter water dissolves 0.000135 gm. lead phosphate at 20° by conductivity method. (Böttger, 1903.)

One liter of 4.97 per cent aqueous acetic acid solution dissolves 1.27 gms. Pb₃(PO₄)₂. (Bertrand, 1868.)

PO

More recent studies of the Solubility of Lead Phosphates in Water, using electrometric methods, are described by Millett and Jowett, 1929, and Jowett and Price, 1932. Their earlier results were found to be in error. Their final determinations for primary lead phosphate, Pb₃(PO₄)₂, secondary lead phosphate, PbHPO₄, and lead pyromorphite, Pb₅(PO₄)₃Cl, the stable salt in presence of chloride ion, have been used for calculating the solubility products of each compound.

LEAD PHOSPHATES, Primary, PbH₂(PO₄)₂; Secondary, PbHPO₄.

EQUILIBRIUM IN THE SYSTEM LEAD OXIDE, PHOSPHORIC ANHYDRIDE AND WATER AT 23°. (Fairhall, 1924.)

The mixtures were rotated in a thermostat for several weeks, and the solutions analyzed from time to time until equilibrium was reached. The composition of the solid phases was determined by the Schreinemaker residue method,

d_{25}° of sat. sol.	Gms. per 100 cc. sat. sol.		Solid Phase.	d_{25}° of sat. sol.	Gms. per 100 cc. sat. sol.		Solid Phase.
	P ₂ O ₅	PbO.			P ₂ O ₅	PbO.	
1.036	5.273	0.138	PbHPO ₄	1.302	45.335	1.175	PbHPO ₄
1.074	10.675	0.245	"	1.375	54.944	1.495	"
1.113	16.060	0.366	"	1.448	66.231	2.142	"
1.151	21.684	0.587	"	1.516	76.906	1.971	PbH ₂ (PO ₄) ₂
1.190	27.263	0.821	"	1.549	82.190	1.547	"
1.227	32.809	0.954	"	1.576	86.406	1.190	"
1.264	39.184	1.001	"	1.635	95.696	0.774	"

LEAD SULFIDE PbS.

SOLUBILITY OF LEAD SULFIDE IN WATER.

t°	Gm. Mols. PbS per liter	Authority
18	3.6×10^{-6}	(Weigel, 1907.)
25	0.94×10^{-6}	(Nims and Bonner, 1929.)
25	4.3×10^{-4} (1)	(Karaoglanov and Sagortschev, 1929.)
25	5.7×10^{-4} (2)	" " "
25	3.62×10^{-11} (3)	(Ravitz, 1936.)
25	6.8×10^{-4} (4)	(Micwitz, 1928.)

S

(1) Solid Phase amorphous PbS; (2) Solid Phase Cryst. PbO; (3) Value recommended on the basis of a study of the published determinations of others (4) Gms. PbS per 1000 gms. sat. solution.

Fusion-point data are given for:

PbS + Ag ₂ S	(Friedrich, 1908.)
" + ZnS	" "
" + Sb ₂ S ₃	(Wagemann, 1912.)
" + Tl ₂ S	(Canneri and Fernandes, 1925.)
" + SiS ₂	(Cambi, 1912.)

LEAD SULFITE PbSO₃·H₂O.

EQUILIBRIUM IN THE SYSTEM LEAD OXIDE, SULFUR DIOXIDE AND WATER.

(Terres and Rühl, 1934.)

The determinations were made by the synthetic method. The results are given in the present paper only in the form of a small diagram from which the following approximate values were read.

SO

Results at 15°

Results at 25°

Mol. Percent in sat. sol.		Solid Phase	Mol. Percent in sat. sol.		Solid Phase
PbO	SO ₂		PbO	SO ₂	
0.005	1.0	PbSO ₃ ·H ₂ O	0.005	2.0	PbSO ₃ ·H ₂ O
0.02	3.0	"	0.01	3.0	"
0.04	5.0	"	0.02	5.0	"
0.07	7.0	"	0.04	7.0	"
0.09	8.0	"	0.05	8.0	"
0.115	9.0	"	0.06	9.0	"
0.12	9.2	" + Pb(HSO ₃) ₂ (?)	0.07	9.6	" + Pb(HSO ₃) ₂ (?)
0.09	10.0	Pb(HSO ₃) ₂ (?)	0.06	10.0	Pb(HSO ₃) ₂ (?)
0.12	11.0*	"	0.065	11.0*	"

* Between 11 and 95 Mol. Percent SO₂ the mixtures separate into liquid layers.

LEAD SULFATE PbSO_4 .

SOLUBILITY IN WATER.

(Average curve from gravimetric results of Dibbits (1874), Beck and Stegmüller (1910) and Pleissner (1907) and conductivity results of Böttger (1903) and Kohlrausch (1904-05).

°.	Gms. PbSO_4 per Liter.	°.	Gms. PbSO_4 per Liter.
0	0.028	20	0.041
5	0.031	25	0.045
10	0.035	30	0.049
15	0.038	35	0.052
18	0.040	40	0.056

Results considerably higher than the above are reported by Sehna (1909). This author finds 0.082 gm. PbSO_4 per liter at 18° and claims that the presence of H_2SO_4 in the PbSO_4 reduces the solubility very greatly. His results for the solubility in presence of small amounts of H_2SO_4 are:

Gms. H_2SO_4 per 1000 cc. solution	0	0.0098	0.0196	0.0980	0.4900	0.9800
Gms. dissolved PbSO_4 per 1000 cc. solution at 20°	0.082	0.051	0.038	0.013	0.006	0.0

Sehna also gives results showing that the solubility in water and dilute H_2SO_4 solutions is exactly the same at 100° as at 20°.

Data for the solubility of PbSO_4 precipitates are given by deKoninck, 1907.

Later determinations of the Solubility of Lead Sulfate in Water by Crockford and Brawley, 1934; Purdum and Rutherford, 1933; Kolthoff and Rosenblum, 1933; and Huybrechts and de Langeron, 1930, gave an average curve from which the following values were taken.

°	Gms. PbSO_4 per liter	°	Gms. PbSO_4 per liter
0	0.0330	25	0.0452
5	0.0354	30	0.0476
10	0.0380	35	0.0500
15	0.0403	40	0.0526
20	0.0427	50	0.0574

SO

1000 cc. H_2O dissolve 0.032 gm. PbSO_4 at 15° as determined by a new optical method using an interferometer of the type described by Janin (*Ann. chim. phys.*, 52, 171, 1858). (Mitchell, 1926)

SOLUBILITY OF LEAD SULFATE IN AQUEOUS SOLUTIONS OF HYDROCHLORIC AND OF NITRIC ACIDS AND OF SODIUM CHLORIDE.

(Beck and Stegmüller, 1910.)

In Aqueous HCl.			In Aq. HNO_3 at 18°.		In Aq. NaCl at 18°.	
Normality of HCl.	Milligrams Pb per 100 cc. Solution.			Normality of HNO_3 .	Normality of NaCl.	Mgm. Pb per 100 cc. Sol.
	At 18°.	At 25°.	At 37°.			
o (=pure H_2O)	2.60	3	3.80	0.1	0.1	11.19
0.1	19	22.18	28.04	0.2	0.2	18.73
0.2	35.70	42.88	54.50	0.3	0.3	26.51
0.3	55.37	65.15	84.04	0.4	0.4	33.76
0.4	75.27	88.80	111.90			

Pb PLUMBUM
LEAD SULFATE

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SOLUBILITY OF LEAD SULFATE IN AQUEOUS SOLUTIONS OF HYDROCHLORIC ACID.
(Huybrechts and Ramelot, 1926.)

Results at 18°

Results at 30°

Gms. per liter		Gms. per liter		Gms. per liter	
HCl	PbSO ₄	HCl	PbSO ₄	HCl	PbSO ₄
0.1	0.0516	4.88	0.384	9.75	0.984
0.5	0.0966	7.5	0.573	24.40	1.767
1.0	0.133	9.75	0.748	48.80	1.583
2.5	0.244	25.0	1.020		
		50.0	0.983		

SOLUBILITY OF LEAD SULFATE IN AQUEOUS SOLUTIONS OF HYDROCHLORIC ACID CONTAINING INCREASING AMOUNTS OF SULFURIC ACID AT 18°.
(Huybrechts, and Ramelot, 1926.)

Results for:

Aq. 0.134 normal HCl Aq. 0.275 normal HCl Aq. 0.687 normal HCl Aq. 1.372 normal HCl

Gms. per liter		Gms. per liter		Gms. per liter		Gms. per liter	
H ₂ SO ₄	PbSO ₄	H ₂ SO ₄	PbSO ₄	H ₂ SO ₄	PbSO ₄	H ₂ SO ₄	PbSO ₄
0.0	0.384	0.0	0.730	0.0	1.020	0.0	0.983
0.16	0.179	0.16	0.522	0.16	1.030	0.18	0.974
0.48	0.124	0.48	0.292	0.48	1.026	1.0	0.950
0.96	0.055	0.96	0.1655	0.96	1.024	5.0	0.922
4.8	0.0157	4.8	0.0505	2.5	0.711	10	0.924
9.6	0.0101	9.6	0.0314	4.8	0.382	23.6	0.911
24.0	0.0109	24.0	0.0202	9.6	0.187	47.2	0.818
49.0	0.0101	48.0	0.0168	48.0	0.066		

SOLUBILITY OF LEAD SULFATE IN AQUEOUS SOLUTIONS OF HYDROCHLORIC ACID CONTAINING INCREASING AMOUNTS OF AMMONIUM SULFATE AT 18°.
(Huybrechts and Ramelot, 1926.)

Results for:

Aq. 0.134 normal HCl Aq. 0.267 normal HCl Aq. 0.687 normal HCl Aq. 1.372 normal HCl

Gms. per liter		Gms. per liter		Gms. per liter		Gms. per liter	
(NH ₄) ₂ SO ₄	PbSO ₄	(NH ₄) ₂ SO ₄	PbSO ₄	(NH ₄) ₂ SO ₄	PbSO ₄	(NH ₄) ₂ SO ₄	PbSO ₄
0.0	0.384	0.0	0.748	0.0	1.020	0.0	0.982
0.2	0.213	0.12	0.616	0.5	1.033	1.0	0.925
1.0	0.069	1.0	0.217	1.0	1.059	2.5	0.882
2.0	0.038	2.0	0.145	2.5	1.071	5.0	0.870
2.5	0.027	5.0	0.047	5.0	0.435	7.5	0.905
5.0	0.015	10.0	0.027	7.5	0.265	10.0	0.748
10.0	0.010	100.0	0.015	10.0	0.206	50.0	0.591
		300.0	0.007	50.0	0.049	100	0.425
				100.0	0.028	200	0.282
				200.0	0.014		

SOLUBILITY OF LEAD SULFATE IN AQUEOUS SOLUTIONS OF PERCHLORIC ACID
AND OF MIXTURES OF PERCHLORIC ACID AND SULFURIC ACID AT 25°.
(Willard and Kassner, 1930)

Dissolved PbSO ₄ .			Dissolved PbSO ₄ .		
Composition of solvent in mols. per liter.	Gms. per 100 cc.	Millimols. per 100 cc.	Composition of solvent in mols. per liter.	Gms. per 100 cc.	Millimols. per 100 cc.
0.1 Mol. HClO ₄	0.0278	0.0917	0.5 Mol. HClO ₄ + 0.01 Mol. H ₂ SO ₄ ..	0.0137	0.0451
0.5 ".....	0.0528	0.1742	0.1 " + 0.02 " ..	0.0024	0.0079
1.0 ".....	0.0714	0.2301	0.5 " + 0.02 " ..	0.0037	0.0220
2.0 ".....	0.0787	0.2596	0.1 " + 0.05 " ..	0.0013	0.0043
3.0 ".....	0.0687	0.2266	0.5 " + 0.05 " ..	0.0030	0.0099
4.2 ".....	0.0490	0.1616	0.1 " + 0.10 " ..	0.0010*	0.0033*
0.1 " + 0.005 Mol. H ₂ SO ₄ ..	0.0070	0.0230	0.1 " + 0.25 " ..	0.0008*	0.0026*
0.5 " + " ..	0.0206	0.0679	0.1 " + 0.50 " ..	0.0003*	0.0010*
1.0 " + " ..	0.0367	0.1211	0.1 " + 0.50 Mol. Pb(ClO ₄) ₂ .	0.0002	0.0007

* Lead determined colorimetrically.

SOLUBILITY OF LEAD SULFATE IN AQUEOUS SOLUTIONS OF NITRIC ACID
AND OF MIXTURES OF NITRIC ACID AND SULFURIC ACID AT 25°.
(Willard, and Kassner, 1930)

Dissolved PbSO ₄ .			Dissolved PbSO ₄ .		
Composition of solvent in mols. per liter.	Gms. per 100 cc.	Millimols. per 100 cc.	Composition of solvent in mols. per liter.	Gms. per 100 cc.	Millimols. per 100 cc.
0.1 Mol. HNO ₃	0.0426	0.1405	1.0 Mol. HNO ₃ + 0.005 Mol. H ₂ SO ₄ ..	0.1007	0.3322
0.5 ".....	0.0992	0.3272	0.5 " + 0.01 " ..	0.0328	0.1082
1.0 ".....	0.2021	0.6667	0.5 " + 0.02 " ..	0.0159	0.0524
2.0 ".....	0.3605	1.1890	0.1 " + 0.05 " ..	0.0015	0.0049
3.0 ".....	0.5389	1.7770	0.5 " + 0.05 " ..	0.0089	0.0293
4.2 ".....	0.7263	2.3960	0.1 " + 0.25 " ..	0.0011	0.0036
0.1 " + 0.005 Mol. H ₂ SO ..	0.0078	0.0257	0.1 " + 0.5 " ..	0.0009	0.0030
0.5 " + 0.005 " ..	0.0398	0.1313	0.1 " + 0.5 Mol. Pb(NO ₃) ₂ .	0.0008	0.0026

SOLUBILITY OF LEAD SULFATE IN AQUEOUS SOLUTIONS OF SULFURIC ACID.
(Frisak, 1922.)

Aqueous lead nitrate solution was added, by means of a buret, to aqueous sulfuric acid solutions at definite temperature untill a permanent cloud remained. The results were plotted and the following values read from the curve.

t°.	Gms. Pb dissolved per 100 gms. sat. solution in Aq. H ₂ SO ₄ containing							
	60°/H ₂ SO ₄ .	65°/H ₂ SO ₄ .	70°/H ₂ SO ₄ .	75°/H ₂ SO ₄ .	80°/H ₂ SO ₄ .	85°/H ₂ SO ₄ .	90°/H ₂ SO ₄ .	95°/H ₂ SO ₄ .
16...	0.002	0.002	0.002	0.0021	0.0025	0.004	0.008	0.024
127...	0.0035	0.0042	0.005	0.007	0.009	0.014	0.024	0.060
149...	0.006	0.0075	0.009	0.013	0.018	0.030	0.055	-
166...	-	0.010	0.014	0.021	0.032	0.048	-	-

SOLUBILITY OF LEAD SULFATE IN AQUEOUS SOLUTIONS OF NITRIC ACID AND OF MIXTURES OF NITRIC AND SULFURIC ACID AT 18°.

(Huybrechts and Ramelot, 1926.)

Results for:

Aqueous HNO_3		Aqueous 0.18 normal HNO_3		Aqueous 0.89 normal HNO_3	
Gms. per liter		Gms. per liter		Gms. per liter	
HNO_3	PbSO_4	H_2SO_4	PbSO_4	H_2SO_4	PbSO_4
5.65	0.2195	0.0	0.348	0.0	1.437
11.32	0.348	0.5	0.0819	0.5	0.777
28.30	0.784	1.0	0.0483	1.0	0.537
56.60	1.437	2.5	0.0202	5.0	0.146
		5.0	0.0183	10.0	0.084
		10.0	0.0082	20.0	0.045
		20.0	0.0078	25.0	0.047
		50.0	0.0065	50.0	0.020

SOLUBILITY OF LEAD SULFATE IN AQUEOUS SOLUTIONS OF NITRIC ACID CONTAINING INCREASING AMOUNTS OF AMMONIUM SULFATE AT 18°.

(Huybrechts and Ramelot, 1926.)

Results for:

Aqueous 0.18 normal HNO_3

Aqueous 0.89 normal HNO_3

Gms. per liter		Gms. per liter		Gms. per liter		Gms. per liter	
$(\text{NH}_4)_2\text{SO}_4$	PbSO_4	$(\text{NH}_4)_2\text{SO}_4$	PbSO_4	$(\text{NH}_4)_2\text{SO}_4$	PbSO_4	$(\text{NH}_4)_2\text{SO}_4$	PbSO_4
0.0	0.348	5.0	0.0146	0.0	1.437	5.0	0.196
0.5	0.097	10.0	0.0090	0.5	0.926	10.0	0.091
1.0	0.0512	25.0	0.0052	1.0	0.722	25.0	0.036
2.5	0.0249	50.0	0.0079	2.5	0.405	50.0	0.020

SOLUBILITY OF LEAD SULFATE IN DILUTE AQUEOUS SOLUTIONS OF SULFURIC ACID AT 20°.

The only fairly closely agreeing results of Pleissner, 1907; Sehnaal, 1909; Dawkins and Weldon, 1922; Huybrechts and Ramelot, 1926 and Purdum and Rutherford, 1933, were plotted and the following values were read from the average curve.

Gms. per liter		Gms. per liter		Gms. per liter	
H_2SO_4	PbSO_4	H_2SO_4	PbSO_4	H_2SO_4	PbSO_4
0.0	0.042	0.5	0.0055	10.0	0.0050
0.05	0.013	1.0	0.0040	20.0	0.0060
0.10	0.010	2.5	0.0040	50.0	0.0075
0.25	0.007	5.0	0.0045	100.0	0.0100

The available results at 30° are approximately one unit in the third place higher than the above values for the flat portion of the curve corresponding to concentrations of sulfuric acid above 0.25 gms. per liter.

SOLUBILITY OF LEAD SULFATE IN CONCENTRATED AQUEOUS SOLUTIONS OF ACIDS.

(Schultz, 1861; Rodwell, 1862.)

In Aq. H_2SO_4 .			In Aq. HCl .			In Aq. HNO_3 .		
(a)	(b)	(c)	(a)	(b)	(c)	(a)	(b)	(c)
1.540	63.4	0.003	1.05	10.6	0.14	1.08	11.6	0.33
1.793	85.7	0.011	1.08	16.3	0.35	1.12	17.5	0.59
1.841	97	0.039	1.11	22	0.95	1.25	34	0.78
			1.14	27.5	2.11	1.42	60	1.01
			1.16	31.6	2.86			

(a) Sp. Gr. of Aq. Acid. (b) Gms. Acid per 100 Gms. Solution. (c) Gms. PbSO_4 per 100 Gms. Solvent.

SOLUBILITY OF LEAD SULFATE IN CONC. SOLUTIONS OF SULFURIC ACID.

(Donk, 1916.)

t°.	Gms. per 100 Gms. Sat. Sol.		Solid Phase.	t°.	Gms. per 100 Gms. Sat. Sol.		Solid Phase.
	H_2SO_4 .	PbSO_4 .			H_2SO_4 .	PbSO_4 .	
0	51.2	0	PbSO_4	100	61.2	0	PbSO_4
0	89.4	0	" + $\text{H}_2\text{SO}_4 \cdot \text{H}_2\text{O}$	100	72.5	0.1	"
0	97	0	H_2SO_4	100	96.3	0.2	"
0	97.2	0.3	" + PbSO_4	100	99.1	0.9	"
50	50.4	0	PbSO_4	200	79	0	"
50	86.7	0.1	"	200	88.8	0.1	"
50	95.1	0.2	"	200	95.5	0.3	"
50	99.3	0.6	"	200	98.9	1.1	"

Additional data for highly concentrated solutions of H_2SO_4 are given by Ditz and Kanhäuser (1916).

SO

SOLUBILITY OF LEAD SULFATE IN CONCENTRATED AND FUMING SULFURIC ACID AT ABOUT 18°. (Ditz and Kanhäuser, 1916.)

The solutions were analyzed after being shaken from time to time during three days, and the analyses repeated after an additional two days.

Per cent concentration of sulfuric Acid			Per cent concentration of sulfuric Acid			Per cent concentration of sulfuric Acid		
H_2SO_4 .	free SO_3 .	Gms. PbSO_4 per 100 gms. sat. sol.	H_2SO_4 .	free SO_3 .	Gms. PbSO_4 per 100 gms. sat. sol.	H_2SO_4 .	free SO_3 .	Gms. PbSO_4 per 100 gms. sat. sol.
91.27	—	0.047	98.63	—	1.29	101.13	5.02	3.54
93.78	—	0.063	98.94	—	1.34	101.45	6.4	3.78
96.04	—	0.147	99.52	—	2.51	102.5	11.1	6.00
97.01	—	0.210	100.01	0.044	4.21	103.4	15.1	7.22
98.11	—	0.54	100.2	0.89	3.97	105.05	22.4	8.23
98.37	—	0.70	100.5	2.22	3.62			

Fusion-point data for mixtures of PbSO_4 and PbWO_4 are given by Jaeger and Germs, 1921.

PLUMBUM
LEAD SULFATE

1414

SOLUBILITY OF LEAD SULFATE IN AQUEOUS SOLUTIONS
OF SULFURIC ACID.

(Crockford and Brawley, 1936; Crockford and Addlestone, 1936.)

Gms. H_2SO_4 per 1000 gms. aq. solvent	Gms. $PbSO_4$ per 1000 gms. sat. solution at:			
	0°	25°	35°	50°
0.0	0.033	0.0445	0.0497	0.0577
0.05	0.008	0.0100	0.0110	0.0240
0.1	0.007	0.0080	0.0100	0.0210
0.2	0.0064	0.0070	0.0080	0.0180
0.5	0.0052	0.0060	0.0066	0.0150
1.0	0.0046	0.0052	0.0051	0.0130
2.0	0.0034	0.0038	0.0045	0.0120
5.0	0.0020	0.0025	0.0043	0.0115
10.0	0.0018	0.0022	0.0042	0.0113
50.0	0.0016	0.0020	0.0040	0.0103
100.0	0.0012	0.0016	0.0038	0.0096
200.0	0.0005	0.0012	0.0028	0.0080
300.0	0.0004	0.0012	0.0020	0.0046
600.0	0.0004	0.0012	0.0020	0.0028
700.0	0.0012	0.0018	0.0024	0.0030
750.0	0.0028	0.0030	0.0038	0.0066
800.0	0.0065	0.0115	0.0240	0.0420
850.0	—	0.0600	0.1000	0.130
900	0.0420	0.200	0.318	0.380
950	0.680(940)	0.800	1.060	1.260
970	3.000	—	—	—
1000	—	18.000	22.000	27.600
1010	—	31.000	36.000	42.000
1020	—	47.000	52.000	56.000
1030	—	63.000	68.000	72.000

In agreement with Donk, 1916, analyses of the solid phases showed that $PbSO_4$ is the only one at these temperatures. The eutectic temperature for $PbSO_4 + H_2SO_4$ was found to be 5.4° . The acid concentration of 104 percent H_2SO_4 corresponds to 80.5 percent SO_3 .

SOLUBILITY OF LEAD SULFATE IN AQUEOUS SOLUTIONS OF POTASSIUM ACETATE
AND OF SODIUM ACETATE AT 25° . (Fox, 1909.)

In Aq. Potassium Acetate.			In Aq. Sodium Acetate.			Solid Phase.
Gms. per 100	Gms. Sat. Sol.	Solid Phase.	Gms. per 100	Gms. Sat. Sol.	Solid Phase.	
$CH_3COOK \cdot (CH_3COO)_2Pb$.			$CH_3COONa \cdot (CH_3COO)_2Pb$.	Na_2SO_4 .		
4.33	2.54	$PbSO_4 + PbK_2(SO_4)_2$	6.69	0.78	0.34	$PbSO_4$
9.03	3.55	"	6.95	0.81	0.35	"
17.81	5.43	"	11.76	2.73	1.26	"
26.58	9.83	"	16.90	5.70	2.49	"
28.82	11.40	"	19.92	8.24	3.60	"
28.93	19.41	"	21.51	10.75	4.68	"

In the case of the CH_3COOK solutions, the double salt $PbK_2(SO_4)_2$ is formed and no SO_4 ions enter the solution.

SOLUBILITY OF LEAD SULFATE IN AQUEOUS SOLUTIONS OF POTASSIUM SULFATE.
(Huybrechts and Ramelot, 1926.)

Results at 18°

Results at 30°

Gms. per liter		Gms. per liter		Gms. per liter		Gms. per liter	
K_2SO_4	$PbSO_4$	K_2SO_4	$PbSO_4$	K_2SO_4	$PbSO_4$	K_2SO_4	$PbSO_4$
0.1	0.0125	5.0	0.0037	0.1	0.0128	5.0	0.0036
0.5	0.0047	10.0	0.0007	0.5	0.0064	7.5	0.0047
1.0	0.0053	30.0	0.0002	0.75	0.0060	10.0	0.0007
2.5	0.0042	100.0	0.0002	1.5	0.0055	20.0	0.0011

SOLUBILITY OF LEAD SULFATE IN AQUEOUS SOLUTIONS OF AMMONIUM ACETATE
AND OF SODIUM ACETATE.

(Noyes and Whitcomb, 1905; Dunnington and Long, 1899; Dibbitts, 1874.)

In Ammonium Acetate.

In Sodium Acetate.

At 25° (N. and W.).				At 100° (D. and L.).			
Millimols per Liter.		Gms. per Liter.		G. $NH_4C_2H_3O_2$ per 100 cc. Solution.		G. $PbSO_4$ per 100 g. Solution.	
$NH_4C_2H_3O_2$	$PbSO_4$	$NH_4C_2H_3O_2$	$PbSO_4$			Gms. per 100 $NaC_2H_3O_2$	Gms. H_2O . $PbSO_4$
0	0.134	0	0.041	28	7.12	2.05	0.054
103.5	2.10	7.98	0.636	32	9.88	8.2	0.853
207.1	4.55	15.96	1.38	37	10.58	41	11.23
414.1	10.10	31.92	3.02	45	11.10		

SO

SOLUBILITY OF LEAD SULFATE IN AQUEOUS SOLUTIONS OF AMMONIUM
ACETATE AT 25°.

(Marden, 1916.)

Gms. per 1000 $NH_4C_2H_3O_2$	Gms. Sat. Sol. $PbSO_4$	Gms. per 1000 $NH_4C_2H_3O_2$	Gms. Sat. Sol. $PbSO_4$	d_{25} of Sat. Sol.
7.96	0.636	53.4	5.60	1.012
15.91	1.370	106.8	16.8	1.024
31.70	3.04	213.7	38.9	1.045

SOLUBILITY OF LEAD SULFATE IN AQUEOUS SOLUTIONS OF AMMONIUM SULFATE.
(Huybrechts and Ramelot, 1926.)

Results at 18°

Results at 30°

Gms. per liter		Gms. per liter		Gms. per liter	
$(NH_4)_2SO_4$	$PbSO_4$	$(NH_4)_2SO_4$	$PbSO_4$	$(NH_4)_2SO_4$	$PbSO_4$
0.1	0.0107	30.0	0.0049	0.1	0.0105
0.5	0.0056	50.0	0.0079	1.0	0.0046
0.75	0.0042	70.0	0.0093	2.5	0.0042
1.00	0.0034	100.	0.0123	5.0	0.0044
5.00	0.0040	150	0.0157	7.5	0.0048
10.0	0.0047	200	0.0107	25.0	0.0060

SOLUBILITY OF LEAD SULFATE IN AQUEOUS SOLUTIONS OF SODIUM SULFATE.
(Huybrechts and de Langereon, 1930.)

Gms. H_2SO_4 per liter aq. solvent	Gms. $PbSO_4$ per liter sat. sol. at 15°	Gms. $PbSO_4$ per liter sat. sol. at 30°	Gms. H_2SO_4 per liter aq. solvent	Gms. $PbSO_4$ per liter sat. sol. at 15°	Gms. $PbSO_4$ per liter sat. sol. at 30°
0.1	0.0079	0.0117	7.5	0.0023	0.0044
0.25	0.0057	0.0083	10.0	0.0027	0.0049
0.50	0.0049	0.0060	25.0	0.0038	0.0057
0.75	0.0045	0.0057	50.0	0.0060	0.0079
1.00	0.0045	0.0057	75.0	0.0083	0.0102
2.50	0.0034	0.0049	100.0	0.0105	0.0124
5.00	0.0023	0.0044	132.0	0.0123	0.0147
			400.0		0.0284

SOLUBILITY OF LEAD SULFATE IN AQUEOUS SOLUTIONS OF:
(Kolthoff and Rosenblum, 1933.)

Sodium Sulfate at 26.5°

Lead Sulfate at 29°

Normality of aq. Na_2SO_4	Normality of dissolved $PbSO_4$	Normality of aq. $Pb(NO_3)_2$	Normality of dissolved $PbSO_4$
0.000505	0.000145	0.000501	0.000148
0.000745	0.000115	0.000750	0.000119
0.001011	0.00010	0.0010	0.000088
0.001505	0.00008	0.0015	0.000076
		0.0025	0.000047

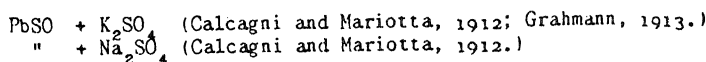
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SOLUBILITY OF LEAD SULFATE IN AQUEOUS SOLUTIONS OF THORIUM CHLORIDE.
(Balcar and Stegmann, 1928.)

To solutions of varying concentrations of thorium chloride, illuminated by a converging beam of light, equivalent solutions of lead chloride and sulfuric acid were added dropwise and the point determined at which the Tyndall cone became permanent. This was taken as the point representing saturation of the solution at 25°. (?)

Gram mols. per liter	
$ThCl_4$	$PbSO_4$
0.0044	0.00323
0.0105	0.00574
0.0233	0.00959
0.0495	0.01760
0.0817	0.01970

Fusion-point data are given for



SOLUBILITY OF BASIC LEAD SULFATES IN WATER AT 18°.

(Pleissner, 1907.)

Compound.	Formula.	One Liter Sat. Solution Contains:		
		Mg. Lead Salt = Mg. Pb = Millimols Pb.		
$\frac{1}{2}$ Basic Lead Sulfate	$\text{PbSO}_4 \cdot \text{PbO}$	13.4	10.6	0.050
$\frac{3}{4}$ Basic Lead Sulfate	$\text{PbSO}_4 \cdot 3\text{PbO} \cdot \text{H}_2\text{O}$	26.2	22	0.106

LEAD PerSULFATE $\text{Pb}(\text{SO}_4)_2$.

SOLUBILITY IN AQUEOUS SULFURIC ACID AT 22°.

(Dolezalek and Finckli, 1906.)

Gms. per Liter.		Solid Phase.	Gms. per Liter.		Solid Phase.
H_2SO_4 .	$\text{Pb}(\text{SO}_4)_2$.		H_2SO_4 .	$\text{Pb}(\text{SO}_4)_2$.	
948	0	$\text{PbOSO}_4 \cdot \text{H}_2\text{O}$	1253	14.85	$\text{PbOSO}_4 \cdot \text{H}_2\text{O}$
1014	0.719	"	1352	16.17	"
1081	1.198	"	1470	9.30	$\text{Pb}(\text{SO}_4)_2$
1098	1.557	"	1532	9.46	"
1130	2.115	"	1631	19.80	"
1180	5.749	"	1698	33.34	"
1217	9.303	"	1703	35.22	"

The solid phase at concentrations of acid up to 1352 gms. per liter is the white basic salt of the composition $\text{PbOSO}_4 \cdot \text{H}_2\text{O}$. In the concentration limits of about 1470-1703 gms. H_2SO_4 per liter the original yellow color of the solid phase remains unchanged.

LEAD (Hypo)SULFATE.

SOLUBILITY OF MIXTURES OF LEAD HYPOSULPHATE AND STRONTIUM HYPOSULPHATE AT 25°.

SO

(Fock — Z. Kryst. Min. 28, 389, '97.)

Mol. per cent in Solution.		Grams per Liter.		Sp. Gr. of Solutions.	Mol. per cent in Solid Phase.	
$\text{PbSO}_4 \cdot 4\text{H}_2\text{O}$.	$\text{SrSO}_4 \cdot 4\text{H}_2\text{O}$.	PbSO_4 .	SrSO_4 .		$\text{PbSO}_4 \cdot 4\text{H}_2\text{O}$.	$\text{SrSO}_4 \cdot 4\text{H}_2\text{O}$.
0.0	100.0	0.0	145.6	1.1126	0.0	100.0
1.05	98.95	2.97	151.2	1.1184	0.30	99.7
15.31	84.69	40.82	152.5	1.1503	3.87	96.13
46.80	53.20	149.2	114.5	1.2147	9.84	90.16
62.30	37.70	256.1	85.0	1.2889	19.26	80.74
75.75	24.25	310.3	67.0	1.3252	23.73	76.27
78.09	21.91	373.7	70.8	1.3726	32.24	67.76
88.29	11.71	509.5	45.6	1.4671	49.97	50.13
100.0	0.00	374.3	0.0	1.6817	0.00	0.00

PHOSPHORUS (White) P_4 .

SOLUBILITY OF WHITE PHOSPHORUS IN SEVERAL SOLVENTS.

(Hildebrand and Buchner, 1920.)

RESULTS FOR SOLUBILITY IN :

Carbon Disulfide.		<i>p</i> Dibrom Benzene.		Ethylene Bromide.		Naphthalene.		Phenanthrene	
t°.	Mol. % P_4 .	t°.	Mol. % P_4 .	t°.	Mol. % P_4 .	t°.	Mol. % P_4 .	t°.	Mol. % P_4 .
-7.8..	6	154.3..	41	169.6..	41	132.8..	26	199.2..	55
-6.7..	34	159.4..	49	165.0..	44	201.4..	49	199.5..	57
-5.9..	43	162.0..	54	163.0..	47	195.5..	56	199.1..	73
-6.4..	50	163.0..	61	165.5..	56	202.7..	60	198.0..	80
-6.4..	59	159.0..	70	162.2..	63	201.6..	74	200 crit. t.	
-6.6..	74	163 crit. t.		151.7..	81	200.2..	75		
-6.5 crit. t.				165 crit. t.		190.4..	80		
						202 crit. t.			

The critical temperatures of solution given above were obtained by plotting the preceding results and reading from the curve. Single determinations in decane and chlorobenzene gave as critical temperatures, $> 390^\circ$ and 264° respectively.

PALLADIUM CHLORIDE 1000.

When a given set of polychlorinated aromatic hydrocarbons was subjected to HPL and then taken with 100% of the other, good agreement was obtained between the two analyses at all times. When a given HPL analysis was performed, the results were reproducible in the same layer.

formation of a black carbon particle. A black carbon particle is a carbonaceous particle that is composed of a nucleus of fused aromatic rings and a mantle of amorphous carbon.

PRASEODYMIUM BROMATE

[illegible]

Date	Inches of Rain		Inches of Snow	
	1900	1901	1900	1901
Jan. 1	0.0	0.0	0.0	0.0
Feb. 1	0.0	0.0	0.0	0.0
Mar. 1	0.0	0.0	0.0	0.0
Apr. 1	0.0	0.0	0.0	0.0
May 1	0.0	0.0	0.0	0.0
June 1	0.0	0.0	0.0	0.0
July 1	0.0	0.0	0.0	0.0
Aug. 1	0.0	0.0	0.0	0.0
Sept. 1	0.0	0.0	0.0	0.0
Oct. 1	0.0	0.0	0.0	0.0
Nov. 1	0.0	0.0	0.0	0.0
Dec. 1	0.0	0.0	0.0	0.0

PRASEODYMIUM ACETATE 709

PRASEODYMIUM GLYCOLATE

The following table contains the results of the regression analysis for the dependent variable $\Delta \ln \text{GDP}$ in the period 1990-1995.

PRASEODYMIUM LACTATE

[illegible]

PRASEODYMIUM SULFONATES

1. *Journal of the American Medical Association*, 1997; 278: 1039-1044.

PRASEODYMIUM OXALATE

Figure 1. The effect of the concentration of the *Agrobacterium* suspension on the transformation efficiency of *Agrobacterium* strains.

PRASEODYMIUM OXALATE

One liter sat. solution of Praseodymium Oxalate in Water, contains 0.00149 gm. $\text{Pr}_2(\text{C}_2\text{O}_4)_3$ at 25° , determined by the gravimetric method and 0.00215 determined by conductivity. (Sarver and Brinton, 1927.)

SOLUBILITY OF PRASEODYMIUM OXALATE IN AQUEOUS SOLUTIONS OF ACIDS AT 25° .

(Sarver and Brinton, 1927.)

Composition of Aq. Solvent in Normality	Gms. $\text{Pr}_2(\text{C}_2\text{O}_4)_3$ per 100 gms. sat. sol.	Composition of Aq. Solvent in Normality	Gms. $\text{Pr}_2(\text{C}_2\text{O}_4)_3$ per 100 gms. sat. sol.
0.1008 HCl	0.0098	6.0 HCl + sat. $(\text{COOH})_2$	0.1492
0.2576 "	0.0279	6.2 " + " "	0.1338
0.5004 "	0.0625	0.2482 HNO_3	0.0278
1.018 "	0.1603	1.992 "	0.5102
1.484 "	0.2658	4.054 "	1.656
2.000 "	0.4108	2.000 " + 0.1 $(\text{COOH})_2$	0.1295
2.865 "	0.6799	3.03 " + 0.1 "	0.5712
0.978 " + 0.1 $(\text{COOH})_2$	0.0128	4.00 " + 0.1 "	1.057
2.000 " + 0.1 "	0.1163	2.00 " + 0.5 "	0.0292
2.865 " + 0.1 "	0.3255	3.03 " + 0.5 "	0.1323
3.965 " + 0.1 "	0.7021	4.00 " + 0.5 "	0.3987
0.978 " + 0.5 "	0.0026	4.00 " + sat. "	0.0663
2.000 " + 0.5 "	0.0173	6.00 " + " "	0.912
2.865 " + 0.5 "	0.0548	0.086 H_2SO_4	0.0103
3.965 " + 0.5 "	0.1833	0.419 "	0.0512
1.484 " + sat. "	0.0046	0.958 "	0.1294
4.0 " + " "	0.0986	1.846 "	0.2808
		2.612 "	0.4213

SOLUBILITY OF PRASEODYMIUM OXALATE IN AQUEOUS SOLUTIONS OF NITRIC ACID ALONE AND CONTAINING OXALIC ACID AT 90° .

(Neckers and Kramers, 1928.)

Normality of aq. HNO_3	Gms. Pr_2O_3 per 100 cc sat. sol.	Normality of aq. HNO_3	Gms. $(\text{COOH})_2$ per 100 gms. solvent	Gms. Pr_2O_3 per 100 cc sat. sol.
0.779	0.3871	0.779	5.0	0.0275
1.558	1.0764	1.558	5.0	0.1639
2.337	1.8467	2.337	5.0	0.6932
5.000	0.8825	5.000	5.0	5.2339

PRASEODYMIUM CHLORIDE PrCl_3 .

SOLUBILITY IN WATER, AQ. HYDROCHLORIC ACID AND IN PYRIDINE.
(Matignon, 1906, 1909.)

Solvent.	t°.	Sp. Gr. Sat. Sol.	Gms. per 100 Gms. Sat. Sol.
Water	13°	1.687	50.96 PrCl_3
Aq. HCl	13°	1.574	41.05 $\text{PrCl}_3 + 7.25 \text{HCl}$
Pyridine	room temp.	...	2.1 PrCl_3

PRASEODYMIUM Trichloride and OXIDE PrCl_3 , Pr_2O_3 .

SOLUBILITY OF PRASEODYMIUM TRICHLORIDE AND OF PRASEODYMIUM OXIDE IN AQUEOUS SOLUTIONS OF AMMONIUM CHLORIDE AT SEVERAL TEMPERATURES. (Prandtl and Rauchenberger, 1920; See Note Neodymium Trichloride, p. 1311.)

The basic chlorides which were obtained were as follows. At 15° , $\text{Pr}_4\text{Cl}_2\text{O}_{5.9}\text{H}_2\text{O}$ at 30° , $\text{Pr}_3\text{ClO}_{4.6}\text{H}_2\text{O}$; at 50° , $\text{Pr}_4\text{Cl}_2\text{O}_5\text{H}_2\text{O}$.

PRASEODYMIUM CHROMATE $\text{Pr}_2(\text{CrO}_4)_3 \cdot 8\text{H}_2\text{O}$.

100 gms. sat. solution of Praseodymium Chromate in water contain 0.021 gm. $\text{Pr}_2(\text{CrO}_4)_3$ at 25° . (Britton, 1924.)

PRASEODYMIUM MOLYBDATE $\text{Pr}_2(\text{MoO}_4)_3$.

One liter water dissolves 0.0152 gm. $\text{Pr}_2(\text{MoO}_4)_3$ at 23° and 0.0143 gms. at 75° . (Hitchcock, 1895.)

NO

PRASEODYMIUM NITRATE $\text{Pr}(\text{NO}_3)_3 \cdot 6\text{H}_2\text{O}$.**SOLUBILITY OF PRASEODYMIUM NITRATE IN WATER.**

(Friend, 1935.)

t°	Gms. $\text{Pr}(\text{NO}_3)_3$ per 100 gms. sat. sol.	Solid Phase
15.8	59.32	$\text{Pr}(\text{NO}_3)_3 \cdot 6\text{H}_2\text{O}$
22.0	60.18	"
30.4	61.94	"
43.0	65.00	"
56.0(m.pt.)	75.15	"

A sat. solution of $\text{Pr}(\text{NO}_3)_3 \cdot 6\text{H}_2\text{O}$ in ethyl ether, prepared by frequent agitation and allowing to stand over night at about 20° , contained 0.004 gm. Pr_2O_3 per 100cc. (Wells, 1930.)

PRASEODYMIUM Magnesium NITRATE $2\text{Pr}(\text{NO}_3)_3 \cdot 3\text{Mg}(\text{NO}_3)_2 \cdot 24\text{H}_2\text{O}$.**SOLUBILITY OF PRASEODYMIUM MAGNESIUM NITRATE IN WATER.**

(Friend and Wheat, 1935.)

t°	Gms. $2\text{Pr}(\text{NO}_3)_3 \cdot 3\text{Mg}(\text{NO}_3)_2 \cdot 24\text{H}_2\text{O}$ per 100 gms. sat. sol.	t°	Gms. $2\text{Pr}(\text{NO}_3)_3 \cdot 3\text{Mg}(\text{NO}_3)_2 \cdot 24\text{H}_2\text{O}$ per 100 gms. sat. sol.
15	63.0 (1)	61.8	74.25
17.8	63.1	70.0	77.5 (1)
30.0	66.4 (1)	74.6	78.39
37.4	67.74	111.2 (m.pt.)	100.0
50.0	71.0 (1)		

(1) Prandtl and Ducrue, 1926.

PRASEODYMIUM Double NITRATESSOLUBILITY AT 16° IN CONC. HNO_3 OF $d_{44} = 1.325$. (Jantsch, 1912.)

Salt.	Formula.	Gms. Hydrated Salt per 100 cc. Sat. Solution.
Praseodymium Magnesium Nitrate	$[\text{Pr}(\text{NO}_3)_6]_2\text{Mg}_3 \cdot 24\text{H}_2\text{O}$	7.70
" Nickel	" Ni_3 "	9.28
" Cobalt	" Co_3 "	12.99
" Zinc	" Zn_3 "	14.69
" Manganese	" Mn_3 "	23.40

PRASEODYMIUM Double NITRATES.

SOLUBILITY OF EACH SEPARATELY IN WATER. (Prandtl and Ducrue, 1926.)

Saturation was obtained by constant agitation.

Salt.		Composition.		Gms. per 100 gms. sat. sol.		Double salt.	
			t°. sat. sol.	P_2O_5			
Praseodymium	Cobalt	Nitrate. $2\text{Pr}(\text{NO}_3)_2 \cdot 3\text{Co}(\text{NO}_3)_2 \cdot 24\text{H}_2\text{O}$	15	1.62	13.64	9.30	CoO 67.6
"	"	" "	30	1.65	14.28	9.75	" 70.8
"	"	" "	45	1.69	14.98	10.13	" 74.3
"	"	" "	60	1.72	15.89	10.79	" 78.8
"	Magnesium	" $2\text{Pr}(\text{NO}_3)_2 \cdot 3\text{Mg}(\text{NO}_3)_2 \cdot 24\text{H}_2\text{O}$	15	1.49	13.55	4.91	MgO 63.0
"	"	" "	30	1.52	14.29	5.24	" 66.4
"	"	" "	50	1.55	15.27	5.55	" 71.4
"	"	" "	70	1.61	16.65	6.14	" 77.5
"	Manganese	" $2\text{Pr}(\text{NO}_3)_2 \cdot 3\text{Mn}(\text{NO}_3)_2 \cdot 24\text{H}_2\text{O}$	15	1.63	14.60	9.44	MnO 71.8
"	"	" "	30	1.68	15.42	9.75	" 75.9
"	"	" "	45	1.73	16.24	10.40	" 79.9
"	"	" "	60	1.79	17.43	11.15	" 85.8
"	Nickel	" $2\text{Pr}(\text{NO}_3)_2 \cdot 3\text{Ni}(\text{NO}_3)_2 \cdot 24\text{H}_2\text{O}$	15	1.60	12.99	8.83	NiO 64.4
"	"	" "	30	1.63	13.83	9.41	" 68.5
"	"	" "	45	1.66	14.50	9.87	" 71.8
"	"	" "	60	1.70	15.27	10.47	" 75.7
"	Zinc	" $2\text{Pr}(\text{NO}_3)_2 \cdot 3\text{Zn}(\text{NO}_3)_2 \cdot 24\text{H}_2\text{O}$	15	1.63	13.22	9.87	ZnO 66.3
"	"	" "	30	1.67	14.08	10.45	" 70.6
"	"	" "	45	1.71	15.02	11.01	" 75.4
"	"	" "	60	1.76	15.97	11.98	" 80.1

NO

PRASEODYMIUM OXIDE Pr_2O_3 .

One liter sat. solution of Praseodymium Oxide in Water contains 0.00000061 gm. mol. Pr_2O_3 at 29°, as determined by electrometric titration. The corresponding value for Pr_6O_{11} is 0.0000039 at 29°.

(Busch, 1927.)

PRASEODYMIUM Dimethyl PHOSPHATE $\text{Pr}_2[(\text{CH}_3)_2\text{PO}_4]_3$.100 gms. H_2O dissolve 64.1 gm. $\text{Pr}_2[(\text{CH}_3)_2\text{PO}_4]_3$ at 25°. (Morgan and James, 1914)

PRASEODYMIUM SULFATE $\text{Pr}_2(\text{SO}_4)_3 \cdot 8\text{H}_2\text{O}$.

SOLUBILITY OF PRASEODYMIUM SULFATE IN WATER.

The somewhat irregular results of Muthmann and Rölig, 1898; Meyer, ----; and Jackson and Rienacker, 1930, were plotted and the following values taken from the average curve drawn through them.

t°	Gms. $\text{Pr}_2(\text{SO}_4)_3$ per 100 gms. sat. sol.	Solid Phase	t°	Gms. $\text{Pr}_2(\text{SO}_4)_3$ per 100 gms. sat. sol.	Solid Phase
0	16.5	$\text{Pr}_2(\text{SO}_4)_3 \cdot 8\text{H}_2\text{O}$	50	6.0	$\text{Pr}_2(\text{SO}_4)_3 \cdot 8\text{H}_2\text{O}$
10	13.5	"	60	4.8	"
20	11.2	"	70	4.0	"
25	10.0	"	80	3.4	"
30	9.0	"	90	1.1(?)	$\text{Pr}_2(\text{SO}_4)_3 \cdot 5\text{H}_2\text{O}$
40	7.2	"	100	0.9(?)	"

EQUILIBRIUM IN THE SYSTEM PRASEODYMIUM SULFATE,
RUBIDIUM SULFATE AND WATER AT 25° .
(Restaino, 1934.)

Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase
$\text{Pr}_2(\text{SO}_4)_3$	Rb_2SO_4		$\text{Pr}_2(\text{SO}_4)_3$	Rb_2SO_4	
4.82	0.30	$\text{Pr}_2(\text{SO}_4)_3 \cdot 8\text{H}_2\text{O}$	0.06	6.72	1.1.8
3.67	0.33	—	0.0	15.22	"
1.98	0.38	—	0.0	17.59	"
1.28	0.41	—	0.0	19.43	"
1.08	0.58	—	0.0	20.84	—

$$1.1.8 = \text{Pr}_2(\text{SO}_4)_3 \cdot \text{Rb}_2\text{SO}_4 \cdot 8\text{H}_2\text{O}.$$

EQUILIBRIUM IN THE SYSTEM PRASEODYMIUM SULFATE, THALLIUM
SULFATE AND WATER AT 25° .
(Zambonini and Restaino, 1931.)

Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase
$\text{Pr}_2(\text{SO}_4)_3$	Tl_2SO_4		$\text{Pr}_2(\text{SO}_4)_3$	Tl_2SO_4	
8.43	0.03	$\text{Pr}_2(\text{SO}_4)_3 \cdot 8\text{H}_2\text{O} + 1.4$	0.10	3.42	$1.3.1 + 1.4\frac{1}{2}$
6.18	0.13	1.1.4	0.0	4.98	$1.4\frac{1}{2}$
0.52	0.73	"	0.0	5.27	1.5
0.18	2.80	"	0.0	5.83	"
0.15	2.98	"	0.0	5.91	" + TlSO_4

$$1.1.4 = \text{Pr}_2(\text{SO}_4)_3 \cdot \text{Tl}_2\text{SO}_4 \cdot 4\text{H}_2\text{O}; 1.3.1 = \text{Pr}_2(\text{SO}_4)_3 \cdot 3\text{Tl}_2\text{SO}_4 \cdot \text{H}_2\text{O}; 1.4\frac{1}{2} = \text{Pr}_2(\text{SO}_4)_3 \cdot 4\frac{1}{2}\text{Tl}_2\text{SO}_4; 1.5 = \text{Pr}_2(\text{SO}_4)_3 \cdot 5\text{Tl}_2\text{SO}_4.$$

PRASEODYMIUM SELENATE $\text{Pr}_2(\text{SeO}_4)_3 \cdot ?\text{H}_2\text{O}$.

SOLUBILITY OF PRASEODYMIUM SELENATE IN WATER.

(Friend, 1932.)

t°	Gms. $\text{Pr}_2(\text{SeO}_4)_3$ per 100 gms. sat. sol.	Solid Phase	t°	Gms. $\text{Pr}_2(\text{SeO}_4)_3$ per 100 gms. sat. sol.	Solid Phase
0.5	26.59	$\text{Pr}_2(\text{SeO}_4)_3 \cdot ?\text{H}_2\text{O}$	55.5	23.99	$\text{Pr}_2(\text{SeO}_4)_3 \cdot ?\text{H}_2\text{O}$
17.4	23.88	"	59.5	23.33	$\text{Pr}_2(\text{SeO}_4)_3 \cdot 12\text{H}_2\text{O}$
24.6	24.29	"	63.6	14.00	"
30.0	24.50	"	67.0	9.96	"
40.2	23.67	"	75.0	6.89	"
48.6	24.00	"	81.0	5.64	"
52.0	23.89	"	92.0	2.99	"

Owing to hydrolysis, especially at the higher temperatures, the saturated solutions were usually slightly acid. Difficulties were experienced in obtaining concordant results. Determinations were also made of the influence of small amounts of free selenic acid upon the solubility of the salt.

PRASEODYMIUM TUNGSTATE $\text{Pr}_2(\text{WO}_4)_3$.One liter water dissolves 0.0438 gm. $\text{Pr}_2(\text{WO}_4)_3$ at 75° .

(Hitchcock, 1895.)

WO

PLATINUM ALLOYS.

SOLUBILITY OF PLATINUM ALLOYS IN NITRIC ACID.

(Winkler — Z. anal. Ch. 13, 369, '74.)

Alloy.	Approx. per cent Pt in Alloy.	Grams Alloy Dissolved per 100 Grams HNO_3 Solution of			
		1.398 Sp. Gr.	1.298 Sp. Gr.	1.190 Sp. Gr.	1.298 Sp. Gr.:
Pt and Silver	10	57	44	69	37
"	5	69	57	51	35
"	2.5	62	61	69	..
"	1	75	70	76	..
Pt and Copper	10	46	27	11	51
"	5	36	34	14	41
"	2.5	51	40	30	..
"	1	52	41	37	..
Pt and Lead	10	7	9	8	..
"	5	8	9	10	..
"	2.5	22	17	11	..
"	1+	21	18	23	..
Pt and Bismuth	10	14	19	4	3
"	5	21	20	6	18
"	2.5	25	42	8	..
"	1	49	64	10	..
Pt and Zinc	10	10	11	19	5
"	5	16	12	6	11
"	2.5	16	24	19	..
"	1	20	32	37	..

PLATINUM BROMIDE PtBr_4 .100 grams sat. aqueous solution contain 0.41 gram PtBr_4 at 20° .

(Halberstadt — Ber. 17, 2962, '84.)

Pt PLATINUM

1424

PLATINUM CHLORIDE $\text{PtCl}_4 \cdot 5\text{H}_2\text{O}$.

100 gms. sat. solution of Platinum Chloride in Water contain 58.7 gms. PtCl_4 at 25° . (Genke, 1926.)

PLATINUM Potassium BROMIDE PtK_2Br_6 .

100 gms. sat. solution in Water contain 2.02 gms. PtK_2Br_6 at 20° .
(Halberstadt)

PLATINIC DOUBLE CHLORIDES of Ammonium, Caesium, Potassium, Rubidium and Thallium. (Data for each separately.)

SOLUBILITY IN WATER.

(Crookes — Chem. News 9, 37, 205, '64; Bunsen — Pogg. Ann. 113, 337, '61.)

t°.	Grams per 100 Grams Water.				
	$(\text{NH}_4)_2\text{PtCl}_6$.	Cs_2PtCl_6 .	K_2PtCl_6 .	Rb_2PtCl_6 .	Tl_2PtCl_6 .
0	...	0.024	0.74	0.184	...
10	0.666 (15°)	0.050	0.90	0.154	0.0064 (15°)
20	...	0.079	1.12	0.141	...
25	...	0.095	1.26	0.143	...
30	...	0.110	1.41	0.145	...
40	...	0.142	1.76	0.166	...
50	...	0.177	2.17	0.203	...
60	...	0.213	2.64	0.253	...
70	...	0.251	3.19	0.329	...
80	...	0.291	3.79	0.417	...
90	...	0.332	4.45	0.521	...
100	1.25	0.377	5.18	0.634	0.050

Cl

SOLUBILITY OF POTASSIUM CHLOROPLATINATE IN WATER AND IN AQUEOUS SOLUTIONS OF POTASSIUM CHLORIDE AND OF SODIUM CHLORIDE.

(Archibald, Wilcox and Buckley, 1908.)

Solubility in Water.		In Aq. KCl at 20° .		In Aq. NaCl at 16° .	
t°.	Gms. K_2PtCl_6 per 100 Gms. H_2O .	Gm. Mols. KCl per Liter.	Gms. K_2PtCl_6 per 100 Gms. Solvent.	Gm. Mols. NaCl per Liter.	Gms. K_2PtCl_6 per 100 Gms. Solvent.
0	0.4784	0.20	0.0236	0	0.672
10	0.5992	0.25	0.0207	0.05	0.700
20	0.7742	0.50	0.0109	0.10	0.729
30	1	1	0.0046	0.25	0.758
40	1.355	2	0.0045	0.50	0.775
60	2.444	3	0.0043	0.75	0.791
80	3.711	4	0.0042	1	0.805
100	5.030	sat.	0.0034	2	0.834

SOLUBILITY OF POTASSIUM CHLOROPLATINATE IN AQUEOUS SOLUTIONS OF METHYL ALCOHOL AND OF ETHYL ALCOHOL AT 20°.

(Archibald, Wilcox and Buckley, 1908.)

Wt. Per cent Alcohol in Solvent.	Gms. K_2PtCl_6 per 100 Gms.:		Wt. Per cent Alcohol in Solvent.	Gms. K_2PtCl_6 per 100 Gms.:	
	Aq. CH_3OH .	Aq. C_2H_5OH .		Aq. CH_3OH .	Aq. C_2H_5OH .
0	0.7742	0.7742	50	0.0625	0.0491
5	0.535	0.491	60	0.0325	0.0265
10	0.412	0.372	70	0.0182	0.0128
20	0.264	0.218	80	0.0124	0.0085
30	0.1831	0.134	90	0.0038	0.0025
40	0.1165	0.076	100	0.0027	0.0009

100 gms. aq. 8.2% isobutyl alcohol dissolve 0.625 gm. K_2PtCl_6 at 20°.

100 gms. aq. sat. isobutyl alcohol dissolve 0.318 gm. K_2PtCl_6 at 20°.

(Archibald, Wilcox and Buckley, 1908.)

One liter of 55% alcohol dissolves 0.150 gm. $(NH_4)_2PtCl_6$ at 15-20°. (Fresenius, 1846.)

"	76%	"	"	0.067	"	"	"	"
"	95%	"	"	0.0037	"	"	"	"

PLATINUM Potassium CHLORIDE

100 gms. of aqueous 2.0 normal KCl solution dissolve 5.03 gms. PtK_2Cl_6 at 100°. (Archibald and Kern, 1917.)

SOLUBILITY OF PLATINUM POTASSIUM CHLORIDE IN AQUEOUS ETHYL ALCOHOL AT 14°.

(Pierrat, 1921.)

Constant agitation for several hours was employed for securing saturation.

Wt. per cent C_2H_5OH in solvent.	Gms. K_2PtCl_6 per liter sat. sol.	Wt. per cent C_2H_5OH in solvent.	Gms. K_2PtCl_6 per liter sat. sol.
0.0	9.3	42.4	0.5
8.7	4.2	58.5	0.2
15.9	2.6	94.7	0.02
27.3	1.4		

DISTRIBUTION OF PLATINUM CHLORIDE BETWEEN WATER AND ETHER AT ORD. TEMP. (Mylus, 1911.)

When 1 gm. of platinum as chloride is dissolved in 100 cc. of aq. 10% HCl and shaken with 100 cc. of ether, 0.01 per cent of the platinum enters the ethereal layer. If water is used instead of 10% HCl, approximately the same per cent of Pt enters the ether layer.

100 cc. anhydrous hydrazine dissolve 1 gm. platonic chloride, with formation of a black precipitate at room temp. (Welsh and Broderson, 1915.)

ChloroPLATINATES of Hydrocarbon Sulfines.

SOLUBILITY OF EACH IN WATER AT 16°. (Strömholm, 1900.)

Chloroplatinate.		Gms. Salt per 100 Gms. Sat. Solution.
Name.	Formula.	
Trimethyl Sulfine Chloroplatinate	$[(CH_3)_3S]_2PtCl_6$	0.47
Dimethyl Ethyl Sulfine Chloroplatinate	$[(CH_3)_2(C_2H_5)S]_2PtCl_6$	3.43
Methyl Diethyl Sulfine Chloroplatinate	$[CH_3(C_2H_5)_2S]_2PtCl_6$	2.42
Triethyl Sulfine Chloroplatinate	$[(C_2H_5)_3S]_2PtCl_6$	1.98

Similar results for more complex sulfines are also given.

PLATINO AMINES.

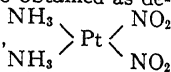
SOLUBILITY IN WATER. (Cleve, 1866 ?)

Amine.	Formula.	Gms. per 100 Gms. H ₂ O.
Platino Semi Diamine Chloride	$\text{Pt} < \begin{smallmatrix} (\text{NH}_3)_2 \\ \text{Cl} \end{smallmatrix}$	0.26 at 0°, 3.4 at 100°
Chloro Platino Amine Chloride	$\text{Cl}_2\text{Pt} < \begin{smallmatrix} \text{NH}_3\text{Cl} \\ \text{NH}_3\text{Cl} \end{smallmatrix}$	0.14 at 0°, 3 at 100°
Chloro Platino Semi Diamine Chloride	$\text{Cl}_3\text{Pt}(\text{NH}_3)_2\text{Cl}$	0.33 at 0°, 1.54 at 100°

PLATINOUS NITRITE AMMONIUM COMPOUNDS.

SOLUBILITY IN WATER. (Tschugaev and Kiltinovie, 1916.)

When ammonia is added to a cold solution of potassium platinonitrite a copious precipitate of the composition $\text{Pt}_2\text{NH}_3(\text{NO}_2)_2$, is obtained. By comparison of the solubility of this precipitate with that of each of three hitherto described ammonioplatinum compounds, it was found that the precipitate obtained as described, corresponds to the *cis* form of dinitro diammonio platinum,



The results for the solubility of *cis* and *trans* dinitro diammonio platinum and of tetra ammonia platinous platinonitrite in water, are as follows:

Gms. Each Compound per 100 Gms. H₂O.

t°.	<i>cis</i> $\text{Pt}_2\text{NH}_3(\text{NO}_2)_2$.	<i>trans</i> $\text{Pt}_2\text{NH}_3(\text{NO}_2)_2$.	$[\text{Pt}_4\text{NH}_3][\text{Pt}(\text{NO}_2)_4]$.
25	0.083	0.063	0.011
63	0.66	0.49	...
74.4	...	0.81	...
95	2.32	1.85	...

Determinations of the solubility of several mixtures of the *cis* and *trans* compounds in water are also given.

PLATINUM CHLORIDE and NITRATE COMPLEX COMPOUNDS

SOLUBILITY OF EACH SEPARATELY IN WATER.

(Tschugaew, 1926.)

t°	Compound	Gms. (s.p.d. per 100 gms. sat. sol.
0	$[\text{Pt}_5\text{NH}_3\text{Cl}]\text{Cl}_3$	14.79
0	$[\text{Pt}_6\text{NH}_3]\text{Cl}_3$	2.83
0	$[\text{Pt}_5\text{NH}_3\text{OH}]\text{Cl}_3$	2.74
0	$[\text{Pt}_5\text{NH}_3\text{Cl}](\text{NO}_3)_3$	0.98
21	"	2.11

RADIUM EMANATIONS

SOLUBILITY IN WATER. (Boyle, 1911; Kofler, 1913.)

t°.	Solubility.		t°.	Solubility.	
	<i>l</i> (Boyle).	α (Kofler).		<i>l</i> (Boyle).	α (Kofler).
0	0.508	0.54	30	0.195	0.205
5	0.41	0.442	40	0.16	0.165
10	0.34	0.37	50	...	0.14
15	0.29	0.31	60	...	0.12
20	0.245	0.265	70	...	0.11
25	0.215	0.232	90	...	0.108

The results of Boyle are in terms of *l*, the Ostwald Solubility Expression (see p. 1136). Those of Kofler are in terms of the expression $\alpha = \frac{V - v}{v} \cdot \frac{E'}{E}$, where *V* and *v* are the volumes involved and *E'* and *E* the total amount of emanation contained respectively in the air and in the liquid.

RADIUM EMANATIONS.

SOLUBILITY OF RADIUM EMANATIONS IN WATER. (Von Antropoff, 1919.)

A highly refined apparatus was used. The results are given in terms of the Ostwald solubility expression l which gives the distribution relation of the gas between the liquid and the gas phase, and in terms of the Bunsen absorption coefficient, β , as modified by Kuenen. This latter is the volume of gas, reduced to normal conditions, dissolved by unit weight of solvent. The author also gives a detailed description of the principles of gas solubility.

t° .	l .	β .	t° .	l .	β .
0.....	0.510	0.510	40.....	0.145	0.126
10.....	0.337	0.326	50.....	0.119	0.100
20.....	0.238	0.222	60.....	0.106	0.085
30.....	0.180	0.162			

SOLUBILITY OF RADIUM EMANATIONS IN ORGANIC SOLVENTS. (Schulze, 1920.)

The results are given in terms of the Ostwald solubility expression l , which is the relation of the concentration of the gas in the liquid to that in the gas space.

Solubility of Radium Emanations, l in :

t° .	Toluene.	Ether.	CHCl_3 .	Acetone.	CS_2 .	$\text{CH}_3\text{COOC}_2\text{H}_5$.	$\text{C}_2\text{H}_5\text{OH}$.	Hexane.	Ra
—18....	27.0	29.1	28.4	10.7	50.3	13.6	11.4	35.2	
—10....	22.5	—	23.8	9.3	41.5	—	—	28.5	
—5....	20.6	21.9	21.6	8.5	37.0	—	—	25.7	
0....	18.4	19.9	19.6	8.0	33.4	9.41	8.28	23.4	
+5....	17.0	18.2	18.1	7.4	—	—	—	21.4	
10....	15.7	16.9	16.7	6.9	27.2	8.0	6.93	19.6	
15....	13.9	15.8	15.6	6.5	—	—	—	17.9	
18....	13.2	15.1	15.0	6.3	23.1	7.16	6.17	16.6	
20....	—	14.8	14.6	6.1	—	—	6.03	—	
25....	11.4	14.0	13.8	5.8	21.5	6.57	—	14.7	
30....	10.5	13.3	13.1	5.6	20.1	—	5.30	13.3	
40....	8.87	—	11.9	5.2	18.1	5.64	4.72	—	
50....	7.6	—	11.2	—	—	5.22	4.26	—	
60....	6.42	—	—	—	—	4.9	—	—	

The solubility l in aniline is 4.43 at 0° and 3.8 at 18° .

The solubility l in benzene is 12.82 at 18° .

The author also quotes data for the densities of the solvents at the several temperatures.

SOLUBILITY OF RADIUM EMANATIONS IN SEVERAL SOLVENTS.

(Ramstedt, 1911; Swinne, 1913.)

Solvent.	Results at 0° .		Results at 18° .		Results at 14° . (Boyle, 1911.)
	l_0 .	Sp. Gr. of Sol.	l_{18} .	Sp. Gr. of Sol.	l_{14}
Water	0.52	0.9999	0.285	0.9986	0.30
Sea Water	...	...	...	...	0.255
Ethyl Alcohol	8.28	0.8065	6.17	0.7911	7.34
Amyl Alcohol	...	...	...	...	9.31
Acetone	7.99	0.8186	6.30	0.7972	...
Aniline	4.43	1.0379	3.80	1.0210	...
Benzene	...	...	12.82	0.8811	...
Carbon Disulfide	33.4	1.2921	23.14	1.2640	...
Chloroform	20.5	1.5264	15.08	1.4907	...
Cyclohexane	...	...	18.04	0.7306	...
Ethyl Acetate	9.41	0.9244	7.34	0.9029	...
Ethyl Ether	20.9	0.7362	15.08	0.7158	...
Glycerol	...	...	0.21	1.262	...
Hexane	23.4	0.6769	16.56	0.6612	...
Toluene	18.4	0.8842	13.24	0.8666	13.7

The above results are in terms of the Ostwald Solubility Expression (see p. 1136).

Ra RADIUM 1428
RADIUM BROMIDE, CHLORIDE and NITRATE.

SOLUBILITY OF EACH SEPARATELY IN WATER AT 20°.
 (Erbacher, 1930.)

The experiments were made on a scale about one-two hundredth that ordinarily employed for solubility determinations. The results are of special interest in connection with the separation of radium from barium by fractional crystallization of their salts. The results are compared in the following table with those for the corresponding bromides, chlorides and nitrates of calcium, strontium and barium.

Salt	Gms. per 100 gms. sat. solution of the salts of:			
	Ca	Sr	Ba	Ra
Bromide	58.8	50.0	51.0	41.4
Chloride	42.7	35.0	26.3	19.7
Nitrate	54.8	41.5	7.9	12.2

The distribution of $\text{Ra}(\text{NO}_3)_2$ between solutions saturated with $\text{Ba}(\text{NO}_3)_2$ and $\text{Pb}(\text{NO}_3)_2$ and the solid salts and mixed crystals of these salts has been extensively studied by Chlopin and his students; Chlopin and Polessitsky, 1928; Chlopin, Polessitsky and Tolmatcheff, 1929; Polessitsky, 1932.

Results for the coefficient of distribution of radium and barium in the fractional crystallization of solutions of their bromides, are given by Walter and Schlundt, 1928.

RADIUM SULFATE RaSO_4 .

SOLUBILITY IN WATER AND IN AQUEOUS SOLUTIONS OF SULFURIC ACID AT 25°.
 (Lind, Underwood and Whittemore, 1918.)

Constant agitation was employed and equilibrium was approached from above and from below. The dissolved radium sulfate was determined by the « emanation » method.

Conc. of H_2SO_4 .	Gm. $\times 10^{-4} \text{RaSO}_4$ per 25 cc. sat. sol.	Conc. of H_2SO_4 .	Gm. $\times 10^{-4} \text{RaSO}_4$ per 25 cc. sat. sol.	Conc. of H_2SO_4 .	Gm. $\times 10^{-4} \text{RaSO}_4$ per 25 cc. sat. sol.
0.0 ($= \text{H}_2\text{O}$)	2.1	10 Per cent	2.4	50 Per cent	2.1
0.01 normal	2.0 (3.0 at 35°)	15 »	2.4	55 »	3.4
0.10 »	2.2	25 »	2.3 (3.3 at 35° and 5.0 at 45°)	60 »	6.3
1.0 »	2.2	30 »	2.3	65 »	6.4
		45 »	1.9	70 »	> 79.0 (not sat.)

Subsequent determinations of the solubility of radium sulfate in water by Erbacher and Nikitin, 1931, made with special reference to the sources of error in the method, resulting from the adsorption of radium by the filtering medium, gave 0.00014 gm. RaSO_4 per 100cc H_2O at 20°. This value is about 67 times greater than the above result by Lind and co-workers. In a later paper Nikitin and Tolmatscheff, 1933, revised this value to 0.00021 gm. RaSO_4 per 100cc H_2O at 20°. They also found that the solubility of radium sulfate in solutions which contain sulfate ions follows the mass action law, taking into consideration the activity coefficient of both ions. The activity product at 20° is equal to 4.25×10^{-11} .

RUBIDIUM Penta BORATE $\text{Rb}_2\text{O} \cdot 5\text{B}_2\text{O}_3 \cdot 8\text{H}_2\text{O}$.

SOLUBILITY OF RUBIDIUM PENTA BORATE IN WATER.

(Rollet and Andrea, 1930, 1931.)

t°	Gms. $\text{Rb}_2\text{O} \cdot 5\text{B}_2\text{O}_3$ per 100 gms. sat. sol.	Solid Phase	t°	Gms. $\text{Rb}_2\text{O} \cdot 5\text{B}_2\text{O}_3$ per 100 gms. sat. sol.	Solid Phase
-0.43	Butee. 1.57	$\text{Ice} + \text{Rb}_2\text{O} \cdot 5\text{B}_2\text{O}_3 \cdot 8\text{H}_2\text{O}$	45	5.75	$\text{Rb}_2\text{O} \cdot 5\text{B}_2\text{O}_3 \cdot 8\text{H}_2\text{O}$
+0.2	1.58	$\text{Rb}_2\text{O} \cdot 5\text{B}_2\text{O}_3 \cdot 8\text{H}_2\text{O}$	60	8.69	"
5	1.72	"	70.4	11.5	"
13.4	2.21	"	82.4	15.2	"
18	2.57	"	88.15	17.75	"
30	3.58	"	102 (b.pt.)	23.75	"

RUBIDIUM Fluor BORATE RbBF_4 .

One liter sat. solution of Rubidium Fluor Borate in water contains 0.035 gm. mol. RbBF_4 at about 20°. (van Liempt, 1927.)

RUBIDIUM BROMIDE RbBr .

SOLUBILITY IN WATER.

(Rimbach, 1905.)

t°.	Gms. RbBr per 100 Gms.			Gms. RbBr per 100 Gms.		Br
	Water.	Solution.		Water.	Solution.	
0.5	89.6	47.26	39.7	131.85	56.87	
5	98	49.50	57.5	152.47	60.39	
16	104.8	51.17	113.5	205.21	67.24	

Freezing-point data for $\text{RbBr} + \text{AgBr}$ are given by Sandonnini (1912a).

100 gms. sat. solution of Rubidium Bromide in Water contain 50.02 gms. RbBr at 18°. (Lannung, 1934.) and 53.69 gms. at 25°. (Fajans and Karagunis, 1931.)

100 gms. sat. solution of Rubidium Bromide in Liquid Ammonia contain 18.23 gms. RbBr at 0°. (Linhard and Stephan, 1934.)

1000 gms. pure Acetone dissolve 0.0505 gm. RbBr at 18° and 0.047 gm. at 37°. (Lannung, 1932.)

100 cc sat. solution of Rubidium Bromide in Ethyl Urethan ($\text{NH}_2\text{COOC}_2\text{H}_5$) contain 0.566 gm. RbBr at 60°. (Stuckgold, 1917.)

RUBIDIUM Iodo BROMIDE RbIBr_2 .

100 gms. sat. solution of Rubidium Iodo Bromide in Water contain about 44 gms. RbIBr_2 and the solution has $d_{20} = 3.84$ at about 20°(?). (Wells and Wheeler, 1892.)

One liter sat. solution of Rubidium Iodo Bromide in Carbon Tetra Chloride contains 0.001 gm. mol. RbIBr_2 at 25°. (Cremer and Duncan, 1931)

RUBIDIUM BROMATE RbBrO_3 .

100 gms. H_2O dissolve 2.93 gms. RbBrO_3 at 25°, 3.55 gms. at 30°, 4.28 gms. at 35° and 5.08 gms. at 40°. (Buell and McCrosky, 1921.)

Rb RUBIDIUM 1430
RUBIDIUM METHIONATE and Chlor Methionate.

SOLUBILITY OF EACH IN WATER AT 25°

Compound	Formula	Gms. Compound per 100 gms. H ₂ O	Authority
Rubidium Methionate	Rb ₂ [CH ₃ (SO ₃) ₂]	4.93	(Backer and Terpstra, 1929.)
Rubidium Chlor Methionate	Rb ₂ [CHCl(SO ₃) ₂]	30.4	(Backer, 1930.)

RUBIDIUM FORMATE HCOORb. 1/2 H₂O.

SOLUBILITY OF RUBIDIUM FORMATE IN WATER. (Sidgwick and Gentle, 1922.)

	Gms. HCOORb per 100 gms. sat. sol.	Solid Phase.	t°.	Gms. HCOORb per 100 gms. sat. sol.	Solid Phase.
- 1.82.	6.23	Ice	16.3.....	84.61	HCOORb.H ₂ O
- 5.62.	15.93		16.5 tr. pt..	—	» +HCOORb.1/2H ₂ O
- 7.82.	20.62		28.3.....	83.60	HCOORb.1/2H ₂ O
-10.62.	25.79		43.6.....	87.77	»
-13.88.	30.62	HCOORb.H ₂ O	49.9.....	89.23	»
+ 3.3..	78.86		46.9.....	80.23 (unstable)	»
7.8..	80.71		51.0 tr. pt..	—	» +HCOORb
9.5..	81.37		60.8.....	90.06	HCOORb
CH 14.0..	83.59	»	101.7.....	93.89	»
			170.0 m. pt..	100.0	»

RUBIDIUM ACETATE CH₃COO Rb.

SOLUBILITY OF RUBIDIUM ACETATE IN WATER.
 (Sidgwick and Gentle, 1922.)

t°.	Gms. CH ₃ COO Rb per 100 gms. sat. sol.	Solid Phase.	t°.	Gms. CH ₃ COO Rb per 100 gms. sat. sol.	Solid Phase.
- 2.79.....	9.59	Ice	— 9.5.....	82.92	CH ₃ COO Rb
- 5.27.....	16.11		+44.7.....	86.23	»
- 6.82.....	19.64	»	99.4.....	89.30	»
-10:27.....	25.57	»	125.2.....	91.35	»
			246.0 m. pt.	100.00	»

RUBIDIUM Phenyl ACETATE RbCH₂C₆H₅COO.

Fusion-point data for RbCH₂C₆H₅COO + CH₃C₆H₅COOH are given by BaKunin and Vitale, 1935.)

RUBIDIUM Dihydroxy TARTARIC ACID Rb₂C₄H₄O₈.3H₂O.

100 gms. H₂O dissolve 6.51 gms. Rb₂C₄H₄O₈.3H₂O at 0°. (Fenton, 1898.)

On account of the unstable character of the compound, only ½ hour was allowed for saturation of the solution.

RUBIDIUM BENZOATE C₆H₅COORb.

SOLUBILITY OF RUBIDIUM BENZOATE IN WATER. (Sidgwick and Ewbank, 1922.)

t°.	Gms. C ₆ H ₅ COORb per 100 gms. sat. sol.	Solid Phase.	t°.	Gms. C ₆ H ₅ COORb per 100 gms. sat. sol.	Solid Phase.
- 1.56.....	9.41	Ice	+15.0.....	56.06	C ₆ H ₅ COORb
- 4.71.....	21.15		51.5.....	59.70	»
- 9.04.....	33.32		82.0.....	63.23	»
-14.75.....	45.75		147.0.....	70.32	»

RUBIDIUM HydroxyBENZOATES *o*, *m* and *p* $C_6H_4OH.COORb$.

SOLUBILITY OF EACH SEPARATELY IN WATER. (Sidgwick and Ewbank, 1922.)

Results for Rubidium Ortho Hydroxy Benzoate (= Rb Salicylate).

t°.	(<i>o</i>) $C_6H_4OH.COORb$ Gms. per 100 gms. sat. sol.	Solid Phase.	t°.	(<i>o</i>) $C_6H_4OH.COORb$ Gms. per 100 gms. sat. sol.	Solid Phase.
— 1.62...	12.34	Ice	21.5...	68.15	(<i>o</i>) $C_6H_4OH.COORb.H_2O$
— 3.69...	23.48	»	27.0...	69.84	»
— 6.34...	33.81	»	49.0...	74.97	(<i>o</i>) $C_6H_4OH.COORb$
— 8.82...	42.77	»	73.0...	77.96	»
— 13.17...	53.40	»	88.0...	79.89	»
+ 8.0....	64.85	(<i>o</i>) $C_6H_4OH.COORb.H_2O$	134.0...	86.36	»

Results for Rubidium
Meta Hydroxy Benzoate.

t°.	(<i>m</i>) $C_6H_4OH.COORb$ Gms. per 100 gms. sat. sol.	Solid Phase.
— 2.23	14.92	Ice
— 6.41	32.13	»
— 13.69	48.88	» + (<i>m</i>) $C_6H_4OH.COORb.H_2O$
+ 14.0	50.61	(<i>m</i>) $C_6H_4OH.COORb.H_2O$
32.5	54.94	»
45.0	60.02	»
64.0	65.04	(<i>m</i>) $C_6H_4OH.COORb$
88.0	70.45	»
105.0	74.49	»
130.0	79.91	»

Results for Rubidium
Para Hydroxy Benzoate.

t°.	(<i>p</i>) $C_6H_4OH.COORb$ Gms. per 100 gms. sat. sol.	Solid Phase.
— 1.17	9.92	Ice
— 2.47	17.47	»
— 4.22	26.22	»
+ 17.5	35.66	(<i>p</i>) $C_6H_4OH.COORb.H_2O$
45.0	45.95	»
68.0	55.73	»
94.0	64.95	(<i>p</i>) $C_6H_4OH.COORb$
120.5	74.00	»
127.0	75.92	»

CH

RUBIDIUM MANDELATE (Racemic and Laevo) $RbC_8H_7O_3$.EQUILIBRIUM IN THE SYSTEM RACEMIC RUBIDIUM MANDELATE,
RACEMIC MANDELIC ACID AND WATER AT 25°.

(Ross and Morrison, 1936.)

Gms. per 100	Gms. sat. sol.	Solid	Gms. per 100	Gms. sat. sol.	Solid
$C_8H_8O_3$	$RbC_8H_7O_3$	Phase	$C_8H_8O_3$	$RbC_8H_7O_3$	Phase
3.9	73.2	1.1	20.1	22.8	1.3
6.5	55.1	"	23.2	20.1	"
8.4	48.9	"	30.8	15.8	"
12.5	43.7	"	43.5	13.9	"
14.3	42.1	"	40.3	13.4	" + $C_8H_8O_3$
20.7	41.0	"	28.9	7.8	$C_8H_8O_3$
21.0	40.1	1.3	21.1	3.7	"
20.0	36.0	"	19.5	2.6	"
19.7	33.7	"	17.8	1.0	"
18.3	27.5	"	16.95	0.0	"

1.1 = $RbC_8H_7O_3.C_8H_8O_3$; 1.3 = $RbC_8H_7O_3.3C_8H_8O_3$.

EQUILIBRIUM IN THE SYSTEM LAEVO RUBIDIUM MANDELATE
LAEVO MANDELIC ACID AND WATER AT 25°.

(Ross, Morrison and Johnstone, 1937.)

Gms. per 100	gms. sat. sol.	Solid	Gms. per 100	gms. sat. sol.	Solid
$\text{C}_8\text{H}_8\text{O}_3$	$\text{RbC}_8\text{H}_7\text{O}_3$	Phase	$\text{C}_8\text{H}_8\text{O}_3$	$\text{RbC}_8\text{H}_7\text{O}_3$	Phase
10.1	0.0	$\text{C}_8\text{H}_8\text{O}_3$	34.2	31.4	$\text{C}_8\text{H}_8\text{O}_3$
10.0	3.1	"	39.0	33.8	"
10.5	6.1	"	41.2	34.3	"
11.3	8.7	"	45.3	40.8	"
13.0	13.7	"	45.8	41.7	"
20.7	21.8	"	45.8	41.7	"
26.9	27.9	"	45.5	44.9	"

Owing to viscosity of the solutions other points on the curve could not be obtained and no acid salt was isolated.

RUBIDIUM Benzene SULFONATES

SOLUBILITY OF EACH SEPARATELY. IN WATER. AT 25°.

(Elgeras, 1929.)

CH

Compound	Formula	Gms. Compound per 100 gms. H_2O
Rb -2- Nitro Benzene Sulfonate	$\text{Rb}[\text{C}_6\text{H}_4(\text{NO}_2)\text{SO}_3]$	16.08
" -3- " " "	"	6.09
" -4- " " "	"	5.80
" -2,4- Dinitro"	$\text{Rb}[\text{C}_6\text{H}_3(\text{NO}_2)_2\text{SO}_3]$	3.90
" -2- Nitro-4-Chlor Benzene Sulfonate	$\text{Rb}[\text{C}_6\text{H}_3(\text{NO}_2)\text{ClSO}_3]$	1.93
" -2- " -5- " " "	"	1.07
" -3- " -6- " " "	"	1.32
" -2- " -4- Brom " "	$\text{Rb}[\text{C}_6\text{H}_3(\text{NO}_2)\text{BrSO}_3]$	1.80

RUBIDIUM BiCARBONATE RbHCO_3 .

100 gms. sat. solution in H_2O contain 53.73 gms. RbHCO_3 at about 20°.
(de Forcrand, 1909.)

RUBIDIUM CARBONATE Rb_2CO_3 .

100 gms. absolute alcohol dissolve 0.74 gm. Rb_2CO_3 .
(Bunsen.)

RUBIDIUM OXALATE $\text{Rb}_2\text{C}_2\text{O}_4$.EQUILIBRIUM IN THE SYSTEM RUBIDIUM OXALATE, ZIRCONIUM
OXALATE AND WATER AT 19°.

(Boulanger, 1936.)

Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase
$\text{Rb}_2\text{C}_2\text{O}_4$	ZrOC_2O_4		$\text{Rb}_2\text{C}_2\text{O}_4$	ZrOC_2O_4	
26.68	0.0	$\text{Rb}_2\text{C}_2\text{O}_4$	11.0	1.2	2.1.1.2
22.5	trace		10.76	1.76	"
22.45	0.2	1.1.1.3	10.67	3.22	"
22.4	0.65	"	9.0	3.0	$\text{ZrO} \cdot \text{C}_2\text{O}_4 \cdot 4\text{H}_2\text{O} (?)$
17.4	0.74	"	8.63	2.63	"
14.5	0.77	"	6.5	2.0	"
12.7	0.91	"	3.50	0.55	"

1.1.1.3 = $\text{Rb}_2\text{C}_2\text{O}_4 \cdot \text{ZrOC}_2\text{O}_4 \cdot (\text{COOH})_2 \cdot 3\text{H}_2\text{O}$.2.1.1.2 = $2\text{Rb}_2\text{C}_2\text{O}_4 \cdot \text{ZrOC}_2\text{O}_4 \cdot (\text{COOH})_2 \cdot 2\text{H}_2\text{O}$.

These double salts obtained only upon evaporation of the solutions.

RUBIDIUM Telluric Acid OXALATE $\text{Rb}_2[\text{H}_6\text{TeO}_6 \cdot \text{C}_2\text{O}_4]$.

SOLUBILITY IN WATER.

(Rosenheim and Weinheber, 1910-11.)

t°	0°	20°	30°	40°	50°
Gms. $\text{Rb}_2[\text{H}_6\text{TeO}_6 \cdot \text{C}_2\text{O}_4]$ per 100 gms. H_2O	3.85	7.26	9.40	12.76	16.90

RUBIDIUM CHLORIDE RbCl .

SOLUBILITY IN WATER.

(Rimbach, 1902; Berkeley, 1904.)

t°	Mols. RbCl per Liter.	Gms. RbCl per 100 Gms.		t°	Mols. RbCl per Liter.	Gms. RbCl per 100 Gms.	
		Water.	Solution.			Water.	Solution.
0	5.17	77.0	43.5	60	6.90	115.5	53.6
10	5.55	84.4	45.8	70	7.12	121.4	54.8
20	5.88	91.1	47.7	80	7.33	127.2	56.0
30	6.17	97.6	49.4	90	7.52	133.1	57.1
40	6.43	103.5	50.9	100	7.71	138.9	58.9
50	6.67	109.3	52.2	112.9	7.95	146.6	59.5

The following determinations of the Sp. Gr. of the sat. solutions are given by Berkeley.

t°	0.55	18.7	31.5	44.7	60.25	75.15	89.35	114*
Sp. Gr.	1.4409	1.4865	1.5118	1.5348	1.5558	1.5746	1.5905	1.6148

* Boiling-point.

100 gms. sat. solution of Rubidium Chloride in Water contain 45.98 gms. RbCl at 18° (Lannung, 1934.) and 48.54 gms. at 25°. (Fajans and Karanganis, 1931.)

100 gms. methyl alcohol dissolve 1.41 gms. RbCl at 25°. (Turner and Bissett, 1913.)
 " ethyl " " 0.078 gm. " " " " "
 " propyl " " 0.015 " " " " "
 " amyl " " 0.0025 " " " " "

100 cc. anhydrous hydrazine dissolve 5 gms RbCl at room temp.

(Welsh and Broderson, 1915.)

1000 gms. Acetone, $(\text{CH}_3)_2\text{CO}$, dissolve 0.0021 gm. RbCl at 18° and 0.0024 gm. at 37°. (Lannung, 1932.)

Rb RUBIDIUM 1434 RUBIDIUM CHLORIDE

100 gms. sat. solution of Rubidium Chloride in Liquid Ammonia contain 0.289 gm. RbCl at 0°. (Linhard and Stephan, 1934.)

100 gms. liquid Sulfur Dioxide dissolve 0.329 gm. RbCl at 0°. (Jander and Ruppolt, 1937.)

100 gms. sat. solution of Rubidium Chloride in Selenium Oxy Chloride (SeOCl₂) contain 3.56 gms. RbCl at 25°. (Wise, 1922.)

Fusion-point data are given for:

Rb ₂ Cl ₂ + Rb ₂ SO ₄	(Dombrovskaya, 1933.)
RbCl + RbNO ₃	(Rostkowski, 1930.)
" + SrCl ₂	(Hofmann, 1927.)
" + AgCl	(Sandonini, 1911, 1914.)
" + TiCl ₄	" " "
" + NaCl	(Zemcznazy and Rimbach, 1910.)

RUBIDIUM Iridium CHLORIDES.

SOLUBILITIES IN WATER. (Delépine, 1908.)

Salt.	Formula.	t°.	Gms. Salt per 100 Gms. H ₂ O.
Rubidium Chloroiridate	Rb ₂ IrCl ₆	19	0.0555
Trirubidium Hexachloroiridite	Rb ₃ IrCl ₆ ·H ₂ O	19	0.91
Dirubidium Aquopentachloroiridite	Rb ₂ IrCl ₅ (H ₂ O)	19	1.05

RUBIDIUM Platinum CHLORIDE Rb₂PtCl₆.

SOLUBILITY OF RUBIDIUM CHLOROPLATINATE IN WATER. (Archibald and Hallett, 1925.)

Saturation obtained by constant agitation for long periods. A weighed amount of the salt was agitated with 100 gms. H₂O and the undissolved portion was determined and the amount dissolved estimated by difference.

t°.	Gms. Rb ₂ PtCl ₆ per 100 gms. H ₂ O.	t°.	Gms. Rb ₂ PtCl ₆ per 100 gms. H ₂ O.	t°.	Gms. Rb ₂ PtCl ₆ per 100 gms. H ₂ O.
0.....	0.0137	40.....	0.0565	80.....	0.1824
10.....	0.0200	50.....	0.0717	90.....	0.2472
20.....	0.0283	60.....	0.0907	100.....	0.3340
30.....	0.0497	70.....	0.1134		

RUBIDIUM Tellurium CHLORIDE Rb₂TeCl₆

100 gms. aq. HCl of 1.2 Sp. Gr. dissolve 0.34 gm. Rb₂TeCl₆ at 23°.

100 gms. aq. HCl of 1.05 Sp. Gr. dissolve 13.09 gms. Rb₂TeCl₆ at 23°. (Wheeler, 1893.)

RUBIDIUM Thallium CHLORIDE RbCl·TlCl₂·2H₂O.

100 gms. H₂O dissolve 13.3 gms. at 18°, and 62.5 gms. at 100°. (Godeffroy, 1886.)

RUBIDIUM CHLORATE RbClO_3 .SOLUBILITY IN WATER.
(Calzolari, 1912.)

t°.	Gms. RbClO_3 per 100 Gms. H_2O .	t°.	Gms. RbClO_3 per 100 Gms. H_2O .
0	2.138	42.2	12.48
8	3.07	50	15.98
19.8	5.36	76	34.12
30	8	99	62.8

There is some uncertainty as to whether the results of Calzolari refer to 100 gms. of H_2O or 100 gms. of saturated solution.

100 gms. H_2O dissolve 3.1 gms. RbClO_3 at 15° (d_{15} of the sat. sol. = 1.07). (Carlson, '10.)

For earlier data see Reissig, 1863.

RUBIDIUM PerCHLORATE RbClO_4 .SOLUBILITY IN WATER.
(Carlson, 1910; Calzolari, 1912.)

t°.	Gms. RbClO_4 per 100 Gms. H_2O .		t°.	Gms. RbClO_4 per 100 Gms. H_2O	
	(Calzolari.)	(Carlson.)		(Calzolari.)	(Carlson.)
0	0.5	1.1 (1.007)	50	3.5	4.6
10	0.6	1.2	60	4.85	6.27 (1.028)
20	1	1.56 (1.010)	70	6.72	8.2
25	1.2	1.8	80	9.2	11.04 (1.050)
30	1.5	2.2	90	12.7	15.5
40	2.3	3.26 (1.017)	100	18	22 (?) (1.070)

ClO

The figures in parentheses are densities of sat. solutions.

100 gms. H_2O dissolve 1.08 gm. RbClO_4 at 21.3°.

(Longuimine, 1862.)

SOLUBILITY OF RUBIDIUM PERCHLORATE IN SEVERAL SOLVENTS, AT 25°.
(Willard and Smith, 1923.)

Solvent.	d_{25}^4 of sat. sol.	Gms. RbClO_4 per 100 gms. sat. sol.	Solvent.	d_{25}^4 of sat. sol.	Gms. RbClO_4 per 100 gms. sat. sol.
Water.....	1.0060	1.320	<i>n</i> Butyl alcohol...	0.8059	0.002
Methyl alcohol...	0.7875	0.060	iso " ...	0.7982	0.004
Ethyl alcohol....	0.7851	0.009	Acetone.....	0.7865	0.095
<i>n</i> Propyl alcohol..	0.7989	0.006	Ethyl acetate.....	0.8945	0.0016

100 cc. sat. solution of rubidium perchlorate in water contain 1.004 gm. RbClO_4 at 20°.
(Moser and Ritchel, 1923.)

SOLUBILITY OF RUBIDIUM PERCHLORATE IN WATER AND
IN AQUEOUS ETHYL ALCOHOL.

(Flatt and Jordan, 1930, 1933.)

t°	Vol. Percent $\text{C}_2\text{H}_5\text{OH}$ in Aq. solvent	Gms. RbClO_4 per 100 gms. solvent
25	0.0	1.276
"	50.0	0.520
"	75.0	0.204
40	50.0	0.954

SOLUBILITY OF RUBIDIUM PERCHLORATE IN MIXTURES OF ETHYL ACETATE
AND ALCOHOLS AT 25°. (Smith, 1925.)

Composition of solvent.					Gms. Rb ClO ₄ per 100 gms sat. sol.
90 vol. %	CH ₃ COO C ₂ H ₅	+	10 vol. %	CH ₃ OH	0.24
80 "	"	+	20 "	"	0.43
90 "	"	+	10 "	C ₂ H ₅ OH	0.16
80 "	"	+	20 "	"	0.10
80 "	"	+	20 "	93 % Alcohol	0.27
90 "	"	+	10 "	n Butyl Alcohol	0.11
80 "	"	+	20 "	"	0.13

RUBIDIUM Potassium PerCHLORATE Rb₂K(ClO₄)₃.

100 gms. sat. solution in H₂O contain 1.55 gms. Rb₂K(ClO₄)₃ at 20° (*d*₂₀ of the sat. solution = 1.013). (Carlson, 1910.)

RUBIDIUM CHROMATE (Mono) Rb₂CrO₄.

CrO

SOLUBILITY IN WATER.
(Schreinemakers and Filippo, Jr., 1906.)

t°.	Gms. RbCrO ₄ per 100 Gms. Solution.	t°.	Gms. RbCrO ₄ per 100 Gms. Solution.	t°.	Gms. RbCrO ₄ per 100 Gms. Solution.
- 7	36.65	50	47.44	- 2.40	15.58
0	38.27	60.4	48.90	- 3.25	20.03
10	40.23	Solid Phase, Ice		- 4.14	24.28
20	42.42	- 0.6	0.95	- 5.55	30.15
30	44.11	- 1.1	7.22	- 6.71	34.31
40	46.13	- 1.57	9.87	about - 7	36.65

EQUILIBRIUM IN THE SYSTEM RUBIDIUM OXIDE, CHROMIUM TRIOXIDE AND
WATER AT 30°.

(Schreinemakers and Filippo, Jr., 1906.)

Gms. per 100	Gms. Sat. Sol.	Solid Phase.	Gms. per 100	Gms. Sat. Sol.	Solid Phase.
CrO ₃ .	Rb ₂ O.		CrO ₃ .	Rb ₂ O.	
0	60.56	RbOH	13.91	3.38	Rb ₂ Cr ₂ O ₇
0	56.82	Rb ₂ CrO ₄	15.05	3.45	" + Rb ₂ Cr ₂ O ₇
0.776	37.88	"	15.31	3.59	Rb ₂ Cr ₂ O ₇
2.89	34.89	"	15.19	3.19	Rb ₂ Cr ₂ O ₇
4.96	30.20	"	18.96	2.37	"
8.54	28.17	"	24.92	1.66	"
11.98	27.99	"	37.34	1.61	"
15.38	28.73	"	48.20	1.54	"
15.54	28.55	" + Rb ₂ Cr ₂ O ₇	53.87	1.67	"
13.69	23.87	Rb ₂ Cr ₂ O ₇	54.29	1.28	" + Rb ₂ Cr ₂ O ₇
9.98	17.56	"	58.69	1.07	Rb ₂ Cr ₂ O ₇
5.72	8.47	"	62.38	0.93	"
4.58	7.98	"	62.74	0.93	"
4.87	4.60	"	63.07	0.92	" + CrO ₃
8.16	3.57	"	62.28	0	CrO ₃

RUBIDIUM DICHROMATE $\text{Rb}_2\text{Cr}_2\text{O}_7$.

RUBIDIUM Rb

SOLUBILITY OF THE POLYMORPHIC FORMS IN WATER.
(Stortenbecker, 1907; see also Wyruboff, 1901.)

t°.	Gms. $\text{Rb}_2\text{Cr}_2\text{O}_7$ per 100 Gms. Sat. Sol.	
	Monoclinic Form.	Triclinic Form.
18	5.42	4.96
24	6.94	6.55
30	9.08	8.70
40	13.22	12.90
50	18.94	18.77
65	28.10	27.30

100 gms. sat. aq. solution contain 9.47 gms. $\text{Rb}_2\text{Cr}_2\text{O}_7$ at 30°.

(Schreinemakers and Filippo, Jr., 1906.)

RUBIDIUM FLUORIDE $\text{RbF} \cdot \frac{1}{2}\text{H}_2\text{O}$.

100 gms. H_2O dissolve 130.6 gms. RbF at 18°.

(de Forcrand, 1911.)

100 gms. sat. solutions of Rubidium Fluoride in Water contain 75.06 gm. RbF at 18°. (Lannung, 1934.)

F

1000 gms. Acetone, $(\text{CH}_3)_2\text{CO}$, dissolve 0.0036 gm. RbF at 18° and 0.0039 at 37°. (Lannung, 1932.)

Freezing-point data for the system $\text{RbF} + \text{HF}$ are given by Webb and Prideaux, 1938.

RUBIDIUM Phospho FLUORIDE RbPF_6 .

One liter sat. solution of Rubidium Phospho Fluoride in Water contain 0.0758 gm. mol. RbPF_6 at 25°. (Lange and Müller, 1930.)

RUBIDIUM Silico FLUORIDE Rb SiF_6 .

100 gms. H_2O dissolve 0.16 gm. Rb_2SiF_6 at 20°, and 1.36 gms. at 100°. (Stolba, 1867.)

RUBIDIUM Titano FLUORIDE Rb_2TiF_6 .

100 cc sat. solution of Rubidium Titano Fluoride in Water contain 0.8 gm. Rb_2TiF_6 at 20-22°. (Ginsberg, 1932.)

RUBIDIUM IODIDE RbI .

SOLUBILITY OF RUBIDIUM IODIDE IN WATER.

I

t°	Gms. RbI per 100 gms. sat. sol.	Authority
6.9	57.9	(Reissig, 1863.)
17.4	60.3	" "
18.0	58.98	(Lannung, 1934.)
25.0	62.05	(Fajans and Karagunis, 1931.)

The system $\text{RbI} + \text{SbI}_3 + \text{H}_2\text{O}$ at 12° was studied by Francois, 1937, but the author gives his results only in the form of a small diagram from which numerical values can not be obtained. The double salt $3\text{RbI} \cdot 2\text{SbI}_3$ was identified and the existence of another probably of the composition $3\text{RbI} \cdot \text{SbI}_3$ was indicated.

The temperature-composition data for the system $\text{RbI} + \text{I}$ for the range 60° to 238° are given by Briggs and Patterson, 1932. The solid phases in contact with the melt are I , RbI_3 and RbI .

Rb RUBIDIUM

1438

SOLUBILITY OF RUBIDIUM IODIDE IN ORGANIC SOLVENTS.
(Walden, 1906.)

Solvent.	Formula.	Gms. RbI per 100 cc. Solution.	
Acetonitrile	CH_3CN	1.478 at 0°	1.350 at 25°
Propionitrile	$\text{C}_2\text{H}_5\text{CN}$	0.274 "	0.305 "
Nitromethane	CH_3NO_2	0.567 "	0.518 "
Acetone	$(\text{CH}_3)_2\text{CO}$	0.960 "	0.674 "
Furfurol	$\text{C}_4\text{H}_3\text{O.CO.H}$	...	4.930 "

Fusion-point data for RbI + AgI are given by Sandonnini (1912a).

1000 gms. Acetone, $(\text{CH}_3)_2\text{CO}$, dissolve 6.52 gms. RbI at 18° and 4.95 gms. at 25°. (Lannung, 1932.)

100 cc sat. solution of Rubidium Iodide in ethyl urethan $(\text{NH}_2\text{COOC}_2\text{H}_5)$ contain 4.079 gms. RbI at 60°. (Stuckgold, 1917.)

100 gms. sat. solution of Rubidium Iodide in Liquid ammonia contain 65.15 gm. RbI at 0°. (Linhard and Stephan, 1934.)

Results for the vapor-pressure, temperature relations of the system RbI + SO_2 are given by Foote and Fleischer, 1931.

RUBIDIUM PerIODIDES**SOLUBILITY IN WATER AT 25°.**
(Foote and Chalke, 1908.)

Gms. per 100 RbI.	Gms. Sat. Sol. I.	Solid Phase.	Gms. per 100 RbI.	Gms. Sat. Sol. I.	Solid Phase.
61.93	0	RbI	28.01	64.85	$\text{RbI}_3 + \text{I}$
59.94	5.90	" + RbI_3	27.85	65.12	"
57.24	8.02	RbI_3	27.83	65.13	"
33.89	38.08	"	27.99	64.98	"

The results show that RbI_7 and RbI_9 are not formed.

RUBIDIUM IODATE RbIO_3 .

100 gms. H_2O dissolve 2.1 gms. RbIO_3 at 23°. (Wheeler, 1892.)

RUBIDIUM PerIODATE RbIO_4 .

100 gms. H_2O dissolve 0.65 gm. RbIO_4 at 13°, d_{20}^{25} of sat. solution = 1.0052. (Barker, 1908.)

RUBIDIUM PERMANGANATE RbMnO_4 .

One liter of aqueous solution contains 6.03 gms. RbMnO_4 at 7°. (Muthmann and Kuntze, 1894.)

100 cc. sat. aq. solution contain 0.46 gm. RbMnO_4 at 2°, 1.06 gms. at 19° and 4.68 gms. at 60°. (Patterson, 1906.)

RUBIDIUM ParaMOLYBDATE $5\text{Rb}_2\text{O} \cdot 12\text{MoO}_3 \cdot \text{H}_2\text{O}$.

100 cc. sat. aq. solution contain 1.941 gms. of the salt at 24°. (Wempe, 1912.)

RUBIDIUM Silico MOLYBDATE and Other Salts.**SOLUBILITY OF EACH SEPARATELY IN WATER AT 20°.**
(Moser and Ritschel, 1925.)

Salt.	Formula.	Gms. salt. per 1000 cc. sat. sol.
Rubidium Silico Molybdate	—	4.1
Rubidium Picrate	$\text{C}_6\text{H}_2(\text{NO}_2)_3\text{O.Rb}$	3.8
Rubidium Phosphotungstate	—	0.075
Rubidium Bitartrate	$\text{Rb.HC}_4\text{H}_4\text{O}_6$	8.52

RUBIDIUM AZIDE RbN_3 .

100 gms. sat. solution of Rubidium Azide in Water contain 51.7 gms. RbN_3 at 16° and 53.3 gms. at 17° . (Curtius and Rissom, 1898.)

RUBIDIUM NITRATE RbNO_3 .

SOLUBILITY IN WATER.

(Berkeley, 1904.)

t° .	Mols. RbNO_3 Per Liter.	Grams RbNO_3 per 100 Gms.		t° .	Mols. RbNO_3 Per Liter.	Gms. RbNO_3 per 100 Gms.	
		Water.	Solution.			Water	Solution.
0	1.27	19.5	16.3	60	7.99	200	66.7
10	2.04	33.0	24.8	70	9.02	251	71.5
20	3.10	53.3	34.6	80	9.93	309	75.6
30	4.34	81.3	44.8	90	10.77	375	78.9
40	5.68	116.7	53.9	100	11.54	452	81.9
50	6.88	155.6	60.9	118.3	12.76	617	86.1

NO

The following Sp. Gr. determinations are also given by Berkeley.

t° .	0.6	15.85	31.55	45.85	63.4	75.60	90.95	118.3*
Sp. Gr. Sat. Sol.	0.1389	1.2665	1.4483	1.6216	1.8006	1.9055	2.0178	2.1867

* Boiling-point.

THE SOLUBILITY AND SUPERSOLUBILITY ICE CURVES FOR RUBIDIUM NITRATE AND WATER.

(Jones, 1908.)

t° of Cryst. of Ice.	Gms. RbNO_3 per 100 Gms. H_2O .		t° of Cryst. of Ice.	Gms. RbNO_3 per 100 Gms. H_2O .	
	Solubility Curve.	Supersolubility Curve.		Solubility Curve.	Supersolubility Curve.
-0.4	1.16	...	-3.5	...	9.94
-1.8	...	1.24	-2.3	13.97	...
-2.1	...	5.39	-4.2	...	13.97
-1.7	9.94	...	-2.7 Cryohydrate	17.11	...

RUBIDIUM HYDROXIDE RbOH .

100 gms. sat. aqueous solution contain 63.39 gms. RbOH at 30° .

(Schreinemakers and Filippo, 1906.)

100 gms. sat. aqueous solution contain 64.17 gms. RbOH at 15° . (de Forcrand, 1909a.)

Fusion-point data for mixtures of $\text{RbOH} + \text{NaOH}$ are given by (v. Hevesy, 1900).

RUBIDIUM Per RHENATE RbReO_4 .

One liter sat. solution of Rubidium Per Rhenate in Water contain 10.5 gm. RbReO_4 at 19.2° and 14.6 gms. at 24.6° . (Noddak and Noddak, 1931.)

ReO

RUBIDIUM Penta SULFIDE Rb_2S_5 .

Fusion-point data for the system $\text{Rb}_2\text{S}_5 + \text{S}$ are given by Biltz and Wilke-Dörfurt, 1906.

RUBIDIUM Di SULFITE $\text{Rb}_2\text{S}_2\text{O}_5$.

100 gms. Liquid Sulfur Dioxide dissolve 0.040 gm. $\text{Rb}_2\text{S}_2\text{O}_4$ at 0° . (Jander and Wickert, 1936; Jander and Ruppolt, 1937.)

RUBIDIUM SULFATE Rb_2SO_4 .

SOLUBILITY IN WATER.

(Etard, 1894; Berkeley, 1904.)

t°.	Mols. Rb_2SO_4 per Liter.	Gms. Rb_2SO_4 per 100 Gms.		t°.	Mols. Rb_2SO_4 per Liter.	Gms. Rb_2SO_4 per 100 Gms.	
		Water.	Solution.			Water.	Solution.
0	1.27	36.4	27.3	60	2.15	67.4	40.3
10	1.46	42.6	29.9	70	2.25	71.4	41.7
20	1.64	48.2	32.5	80	2.34	75.0	42.9
30	1.79	53.5	34.9	90	2.42	78.7	44.0
40	1.92	58.5	36.9	100	2.49	81.8	45.0
50	2.04	63.1	38.7	102.4	2.50	82.6	45.2

The following Sp. Gr. determinations are also given by Berkeley.

t°.	0.5	15.80	31.6	44.2	57.90	74.75	89.45	102.4*
Sp.Gr.Sat.Sol.	1.2740	1.3287	1.3704	1.3998	1.4232	1.4480	1.4649	1.4753

* b. pt.

100 cc. sat. solution in absolute H_2SO_4 contain 58.81 gms. Rb_2SO_4 .

(Bergius, 1910.)

SOLUBILITY OF RUBIDIUM DOUBLE SULFATES IN WATER AT 25°

(Locke, 1902.)

Formula.	Per 100 cc. H_2O .		Formula.	Per 100 cc. H_2O .	
	Gms. Anh. Salt.	Mols. Salt.		Gms. Anh. Salt.	Mols. Salt.
$\text{Rb}_2\text{Cd}(\text{SO}_4)_2 \cdot 6\text{H}_2\text{O}$	76.7	0.1615	$\text{Rb}_2\text{Mn}(\text{SO}_4)_2 \cdot 6\text{H}_2\text{O}$	35.7	0.0857
$\text{Rb}_2\text{Co}(\text{SO}_4)_2 \cdot 6\text{H}_2\text{O}$	9.28	0.022	$\text{Rb}_2\text{Mg}(\text{SO}_4)_2 \cdot 6\text{H}_2\text{O}$	20.2	0.0521
$\text{Rb}_2\text{Cu}(\text{SO}_4)_2 \cdot 6\text{H}_2\text{O}$	10.28	0.0241	$\text{Rb}_2\text{Ni}(\text{SO}_4)_2 \cdot 6\text{H}_2\text{O}$	5.98	0.0142
$\text{Rb}_2\text{Fe}(\text{SO}_4)_2 \cdot 6\text{H}_2\text{O}$	24.28	0.0579	$\text{Rb}_2\text{Zn}(\text{SO}_4)_2 \cdot 6\text{H}_2\text{O}$	10.10	0.0236

RUBIDIUM ALUMS.

SOLUBILITY IN WATER.

(Locke, 1901.)

Alum.	Formula.	t°.	Gms. Alum per 100 Gms. H_2O .		
			Anhydrous.	Hydrated.	G. Mols.
Rb. Aluminum Alum	$\text{RbAl}(\text{SO}_4)_2 \cdot 12\text{H}_2\text{O}$	25	1.81	3.15	0.0059
"	"	30	2.10	...	0.0072
"	"	35	2.66	...	0.0087
"	"	40	3.22	...	0.0106
Rb. Chromium Alum	$\text{RbCr}(\text{SO}_4)_2 \cdot 12\text{H}_2\text{O}$	25	2.57	4.34	0.0079
"	"	30	3.17	...	0.0096
"	"	35	4.11	...	0.0128
"	"	40	5.97	...	0.0181
Rb. Vanadium Alum	$\text{RbV}(\text{SO}_4)_2 \cdot 12\text{H}_2\text{O}$	25	5.79	9.93	0.0177
Rb. Iron Alum	$\text{RbFe}(\text{SO}_4)_2 \cdot 12\text{H}_2\text{O}$	25	9.74	16.98	0.0294
"	"	30	20.24	...	0.0617

Biltz and Wilke, 1906, find for the solubility of rubidium iron alum in water, at 6.6°, 4.55 gms. per 100 cc. solution; at 25°, 29 gms; and at 40°, 52.6 gms.

Fusion-point data for mixtures of $\text{Rb}_2\text{SO}_4 + \text{K}_2\text{Cl}_2$ are given by Dombrovskaya, 1933.

RUBIDIUM SELENATE Rb_2SeO_4 .100 gms. H_2O dissolve 158.9 gms. Rb_2SeO_4 at 12° .

(Tutton, 1897.)

SOLUBILITY OF MIXED CRYSTALS OF RUBIDIUM ACID SELENATE AND RUBIDIUM ACID TELLURATE AND OF RUBIDIUM ACID SULFATE AND RUBIDIUM ACID TELLURATE IN WATER AT 25° . (Pellini, 1909.)

Results for $\text{RbHSeO}_4 + \text{RbHTeO}_4$.

Gms. per 1000 cc. Sat. Sol.	Mol. % Selenate
RbHSeO_4	in Solid Phase.
76.46	39.51
95.82	51.55
171.70	35.30
462.80	52.22
859.30	22.98
	53.95
	56.33
	67.46

Results for $\text{RbHSO}_4 + \text{RbHTeSO}_4$.

Gms. per 1000 cc. Sat. Sol.	Mol. % Sulfate
RbHSO_4	in Solid Phase.
26.675	38.403
32.117	47.91
42.917	31.58
59.074	50.33
498.25	26.764
	50.74
	50.99
	52.52

RUBIDIUM SILICOTUNGSTATE $\text{Rb}_8\text{SiW}_{12}\text{O}_{42}$.100 gms. H_2O dissolve 0.65 gm. $\text{Rb}_8\text{SiW}_{12}\text{O}_{42}$ at 20° , and 5.1 gms. at 100° .

(Godeffroy, 1876.)

RHODIUM SALTS. SOLUBILITY IN WATER.

(Jorgensen — J. pr. Ch. [2] 27. 433, '83; 34. 394, '86; 44. 51, '91.)

Salt.	Formula.	t°.	Gms. per 100 Gms. H_2O .
Chloro Purpureo Rhodium Chloride	$\text{ClRh}(\text{NH}_3)_5\text{Cl}_2$	17	0.56
Luteo Rhodium Chloride	$\text{Rh}(\text{NH}_3)_6\text{Cl}_3$	8	13.3
Luteo Rhodium Nitrate	$\text{Rh}(\text{NH}_3)_6(\text{NO}_3)_3$	ord. t.	2.1
Luteo Rhodium Sulphate	$[\text{Rh}(\text{NH}_3)_6]_2(\text{SO}_4)_3 \cdot 5\text{H}_2\text{O}$	20	2.3

Cl

RHODIUM Pentammin Chloro CHLORIDE $[\text{Rh}(\text{NH}_3)_5\text{Cl}]\text{Cl}_2$.

100 gms. sat. solution of the salt in water contain 0.828 gm.
 $[\text{Rh}(\text{NH}_3)_5\text{Cl}]\text{Cl}_2$ at 25° . (Semzusni, 1927.)

RHODIUM dextro and racemic Di amino Cyclo PENTANES.

Data for the solubility of these complex compounds in water are given by Jaeger and Blumendal, 1928.

RUTHENIUM SALTS**SOLUBILITIES IN WATER.**

(Howe, 1894.)

Salt.	Formula.	t°.	Gms. Salt per 100 Gms. H_2O .
Ruthenium Potassium Nitrosochloride	$\text{K}_2\text{RuCl}_5\text{NO}$	25	12
" " "	"	60	80
" Ammonium Nitrosochloride	$(\text{NH}_4)_2\text{RuCl}_5\text{NO}$	25	5
" " "	"	60	22
" Rubidium Nitrosochloride	$\text{Rb}_2\text{RuCl}_5\text{NO}$	25	0.57
" " "	"	60	2.13
" " (hydrated)	$\text{Rb}_2\text{RuCl}_5\text{NO} \cdot 2\text{H}_2\text{O}$	25	114.3
" Caesium Nitrosochloride	$\text{Cs}_2\text{RuCl}_5\text{NO}$	25	0.20
" " "	"	60	0.56
" " (hydrated)	$\text{Cs}_2\text{RuCl}_5\text{NO} \cdot 2\text{H}_2\text{O}$	25	105.8

In a series of papers by Aten (1905-06, 1912, 1912-13, 1913, 1914 and 1914a), the preparation and properties of the four known modifications of sulfur are described. These are designated by the symbols, S_λ , S_μ , S_π and S_ρ .

S_λ is ordinary rhombic sulfur and its molecule is considered to be composed of eight atoms of sulfur, S_8 .

S_μ is the insoluble, so-called amorphous sulfur.

S_π is obtained when ordinary sulfur is heated above its melting-point and quickly cooled; it is especially easily prepared by warming S_λ in sulfur chloride. Its molecule is probably represented by S_4 .

S_ρ was discovered by Engel and is prepared by mixing concentrated HCl, cooled to 0° , with saturated sodium thiosulfate solution. The precipitated NaCl is removed by filtration and the solution extracted with toluene. The aqueous layer soon yields a cloudy precipitate of S_ρ . The molecule of this sulfur is considered to have the composition S_8 .

SOLUBILITY OF SULFUR (S_λ) IN SULFUR MONOCHLORIDE (S_2Cl_2) DETERMINED BY THE MELTING-POINT METHOD.

(Aten, 1905-06.)

t° of Melting.	Mol. % S_8 in Mixture.	Solid Phase.	t° of Melting.	Mol. % S_8 in Mixture.	Solid Phase.
-16	4.3	Rhombic S	83.5	67	Rhombic S
0	6	"	95.6	81.8	"
+17.9	9.9	"	86	81.8	Monoclinic S
36.8	17.1	"	103.2	88.4	"
55.2	28.5	"	110.4	95	"
65.6	40.3	"	118.8	100	"
77.7	55.4	"			

More recent determinations of freezing-points in the above system are given by Lowry, McHatton and Jones, 1927.

Results for the solubility of sulfur in sulfur chloride, determined by the synthetic method upon mixtures as such and after preheating to various temperatures, are given by Hammick and Zvegintzof, 1928. These authors point out that the conclusions of Lowry, McHatton and Jones are incorrect in certain respects.

SOLUBILITY OF SULFUR (S_π) IN SULFUR MONOCHLORIDE (S_2Cl_2)

(Aten, 1912-13.)

A preliminary experiment showed that if a solution of S_λ in sulfur monochloride, saturated at 20° , is heated to 170° and cooled, it will then dissolve as much S_λ as already required to saturate it. The following determinations were made by sealing known amounts of S_λ and S_2Cl_2 in tubes, heating them to 100° for several hours and then cooling quickly to the indicated temperatures and shaking for $\frac{1}{2}$ hour in the case of the 0° and 25° results and 2 hours in the case of the -60° results. The saturated solutions were analyzed by oxidizing with HCl + HNO_3 + Br and titrating the H_2SO_4 , after removing the volatile acids.

Atoms S per 100 Atoms S + S_2Cl_2 in:				Atoms S per 100 Atoms S + S_2Cl_2 in:			
Original Mixture.	Saturated Solution at:			Original Mixture.	Saturated Solution at:		
	-60° .	0° .	$+25^\circ$.		-60° .	0° .	$+25^\circ$.
0	11.6	36.1	53.5	79.4	65.2	72	...
10	18.1	40.1	57.6	80.1	66.1	71.6	...
28.7	31.9	47.4	62	89.9	...	...	82.1
49.9	42.9	56	66.4	90.1	...	80.5	...
60.1	47.7	59.9	69.4	94.6	...	...	87.7
69.1	...	...	72.8	98	...	...	93.4

Results similar to the above are also given (Aten, 1912), for mixtures previously heated to 50° , 75° and 125° . All the data confirm the formation of the new modification S_π .

SOLUBILITY OF SULFUR (S_8) IN SULFUR MONOCHLORIDE (S_2Cl_2) AT 25°.
(Aten, 1912, 1913.)

The samples were heated to the temperatures indicated and rapidly cooled and powdered. The method of determining the solubilities is not described.

Previous Treatment of Sample.	Atoms S Dis- solved per 100 Atoms S_2Cl_2 .	
Unheated Sulfur	53.5	
Mixture of Rhombic and Amorphous Sulfur	54.5	
Rhombic Sulfur heated to 125°	56-58.5	(depending on excess of S present.)
" " " " 165°	60	(determined immediately.)
" " " " 165°	59.5	" after 1 hr.)
" " " " 165°	57.5	" 24 hrs.)
" " " " 165°	53.2	" 8 days.)

100 gms. sat. sol. of sulfur in selenium monochloride ($SeCl_2$) contain 48.81 gms. S at 25°.
(Lenher and Kao, 1926.)

SOLUBILITY OF SULFUR IN THE PERSULFIDES OF HYDROGEN.
(Walton and Whitford, 1923.)

The mixtures were constantly stirred in a quartz tube with a quartz stirrer and the solution analyzed repeatedly until equilibrium had been reached. The analysis was made by adding acetone to decompose the persulfide. The solvents were then allowed to evaporate spontaneously and the residue of rhombic sulfur dried at 90° to constant weight as « sulfur not evolved as hydrogen sulfide ». The existence of a compound having the composition H_2S_6 , and stable below — 1°.⁴⁵ was established. Hydrogen disulfide (H_2S_2) and hydrogen trisulfide (H_2S_3) dissolve sulfur copiously. When these two liquids are saturated with sulfur at a given temperature the two resulting liquid phases have the same composition. The following results were obtained for the solubility of sulfur in the trisulfide of hydrogen.

t°.	Per cent S in sat. sol. not evolved as H_2S .	t°.	Per cent S in sat. sol. not evolved as H_2S .	t°.	Per cent S in sat. sol. not evolved as H_2S .
—34.72....	53.56	— 1.45....	82.50	35.4.....	89.46
—15.42....	71.18	+ 0.05....	82.97	45.15....	91.00
—10.6.....	75.16	17.92...	86.77	55.3.....	92.49
— 3.75....	80.71	25.4.....	87.98		

SOLUBILITY OF SULFUR IN AQUEOUS SOLUTIONS OF ALKALIES AT THE
ORDINARY TEMPERATURE. (Calcagni, 1920.)

Solvent.	Gms. S per 100 cc. of sat. solution.	Solvent.	Gms. S per 100 cc. of sat. solution.
Aq. Ammonia ($d=0.888$)...	1.367	Aq. saturated $Mg(OH)_2$...	0.014
Aq. 66% KOH.....	17.70	" $Ca(OH)_2$...	0.112
" NaOH.....	24.55	" $Ba(OH)_2$...	2.60

No difference was found between solutions which had been kept in the dark and in the light.

SOLUBILITY OF SULFUR IN AQUEOUS SODIUM SULFIDE SOLUTIONS.

(Küster and Heberlein, 1905.)

The results are expressed in terms of x which represents the number of S atoms dissolved for each Na_2 in the solution. The figures, therefore, show the atomic ratio of S to Na_2 in the saturated solution and at the same time, the sulfur content of the compound Na_2S_x which is formed. In order to find the actual amount of sulfur dissolved per liter, it is only necessary to multiply the x value by the normality of the aqueous sodium sulfide solution used as solvent in the particular case.

A series of determinations made at 25° , by agitating aqueous sodium sulfide solutions with crystalline sulfur until equilibrium was reached, and then diluting each solution with an equal volume of water and shaking with excess of sulfur until equilibrium was again reached, gave the following results:

Normality of the Aq. Na_2S Solution.	x in the Resulting Na_2S_x .	Normality of the Aq. Na_2S Solution.	x in the Resulting Na_2S_x .
4	4.475	0.125 (32 hrs.)	5.225
2 (2 hrs.)	4.666	0.0625	5.239
1	4.845	0.03125	5.198
0.5	4.984	0.015625	5.034
0.25	5.115	0.007812 (128 hrs.)	4.456

The figures in parentheses in the above table show the number of hours required for attainment of equilibrium in these three cases. The authors also made determinations of the influence of temperature on the amount of sulfur dissolved, and found that for a normal Na_2S solution, the x value did not vary appreciably from the figure given above, over the range 0° to 50° .

Results are also given showing the influence of the presence of NaCl and of KOH on the amount of sulfur dissolved by aqueous Na_2S solutions. In the former case the solubility was distinctly lowered, while in the latter it was notably increased.

SOLUBILITY OF SULFUR IN LIQUID AMMONIA.

(Ruff and Hecht, 1911.)

At the temperatures 0° to 40° , the solutions were constantly shaken for 3 to 4 days. For the results at the lower temperatures the solutions were saturated at room temperature then cooled, partially evaporated and shaken 4 to 6 hours. The saturated solutions were analyzed by evaporation of the ammonia by means of a current of hydrogen, absorbing in HCl and converting to the platinic chloride for weighing. The S residues were dried at 100° , with proper precautions, and weighed.

t° .	Gms. S per 100 Gms. Sat. Solution.	t° .	Gms. S per 100 Gms. Sat. Solution.
-78	38.6*	+16.4	25.65
-20.5	38.1*	30	21
0	32.34	40	18.5

* This figure corresponds to the compound $\text{S}(\text{NH}_3)_3 = 38.5\% \text{ S}$.

SOLUBILITY OF SULFUR IN ETHYL AND METHYL ALCOHOLS.

t° .	Alcohol.	Gms. per 100 Gms. Alcohol.	Authority.
15	Abs. Ethyl	0.051	(Pohl.)
18.5	"	0.053	(de Bruyn — Z. physik. Chem. 10, 781, '92.)
b. pt.	"	0.42	(Payen — Compt. rend. 34, 356, '52.)
18.5	Abs. Methyl	0.028	(de Bruyn.)

SOLUBILITY OF SULFUR IN AQUEOUS ACETONE AT 25°.

(Herz and Knoch, 1905.)

Wt. Per cent Acetone in Solvent.	Sulfur per 100 cc. Solution.		Sp. Gr. of Solution.
	Millimols.	Gms.	
100	65	2.084	0.7854
95.36	45	1.442	0.7911
90.62	33	1.058	0.8165
85.38	25.3	0.811	0.8295

SOLUBILITY OF SULFUR IN SEVERAL SOLVENTS AT 25°.

(Hoffmann, Kirmreuther and Thal, 1910.)

Solvent	Formula	Gms. S ₈ per 100 gms. sat. sol.
Tetra chlor ethylene	$\text{CCl}_2:\text{CCl}_2$	1.507
Penta chlor ethane	$\text{CCl}_3.\text{CHCl}_2$	1.183
Acetylene di chloride	$\text{CHCl}:\text{CHCl} (?)$	1.260
Tetra chlor ethane	$\text{CHCl}_2.\text{CHCl}_2$	1.214

SOLUBILITY OF SULFUR IN TRIPHENYL METHANE, DETERMINED BY THE SYNTHETIC METHOD.

Results of Smith, Holmes & Hall, 1905.

% Triphenyl Methane in Mixture.	t° of First Limit of Mixing.	% Triphenyl Methane in Mixture.	t° of Second Limit of Mixing.
69.1	108.5	35.5	214.5
58.8	127	32.5	211
50.8	136.5	28.4	206
46.6	141	24.5	203
42.8	144	21.6	200
37.8	146	19.2	199
33.7	146.5	15.4	198
30.3	147		
25.4	146		

Results of Kruyt, 1908-09.

% Triphenyl Methane in Mixture.	t° of First Limit of Mixing.	% Triphenyl Methane in Mixture.	t° of Second Limit of Mixing.
66.7	113	7	211.5
60.2	125.3	9.3	201.5
50.2	136.8	12	198.8
41	144.2	13.7	199.5
30.8	146	16.4	200.4
20	145.2	19.8	202.1
13.2	137.6	23.5	203.7
8.1	118.6	28.7	208
7	crystals	34.5	215.2

Later results for this system are given by Mondain-Monval and Schneider, 1928.

SOLUBILITY OF SULFUR IN:

Tin Tetrachloride.

(Gerardin, 1865.)

t°.	Gms. S per 100 Gms. SnCl ₄ .	Solid Phase.
99	5.8	Solid S
101	6.2	"
110	8.7-9.1	"
112	9.4-9.9	Liquid S
121	17.0	"

Amyl Alcohol.

(Gerardin.)

t°.	Gms. S per 100 Gms. C ₅ H ₁₁ OH.	Solid Phase.
95	1.5	Solid S
110	2.1-2.2	"
112	2.6-2.7	Liquid S
120	3.0	"
131	5.3	"

SOLUBILITY OF SULFUR IN CARBON TETRACHLORIDE.
(Hildebrand and Jenks, 1921; Delaplace, 1922; Jacek, 1926.)

t°.	Gms. S per 100 gms. sat. sol.	t°.	Gms. S per 100 gms. sat. sol.	t°.	Gms. S per 100 gms. sat. sol.
-24.0....	0.148 (J.)	0.0...	0.339 (H. and J.)	25....	0.831 (H. and J.)
-20.75...	0.185 »	15.5...	0.641 (D.)	35....	1.155 »
-11.25...	0.255 »	18.....	0.720 »	45....	1.564 »
-9.0....	0.277 »	22.....	0.748 »	54....	2.008 »
0.0....	0.366 »	23.25..	0.841 (J.)		

SOLUBILITY OF SULFUR IN CARBON DISULFIDE.
(Jacek, 1915.)

Saturation was secured by constant agitation and all necessary precautions were taken for accurate work.

t°.	Gms. S per 100 gms. CS ₂ .	t°.	Gms. S per 100 gms. CS ₂ .	t°.	Gms. S per 100 gms. CS ₂ .
-109.5.....	1.05	-65.....	3.674	-36.5.....	7.950
-86.0.....	2.24	-59.....	4.387	-25.0.....	10.960
-81.5.....	2.443	-47.....	5.889	-17.0.....	13.96
-74.0....	2.89	-44.....	6.440	-13.0.....	15.28
				0.0.....	23.13

SOLUBILITY OF SULFUR IN CHLOROFORM IN ETHYL ETHER AND IN ETHYLENE
CHLORIDE.

In Chloroform. (Delaplace, 1922.)		In Ethyl Ether (anh.). (Delaplace, 1922.)		In Ethylene Chloride. (Hildebrand and Jenks, 1921.)	
t°.	Gms. S per 100 gms. sat. sol.	t°.	Gms. S per 100 gms. sat. sol.	t°.	Gms. S per 100 gms. sat. sol.
13.....	0.790	13.....	0.187	25.....	0.826
15.....	0.868	23.....	0.283	40.....	1.380
24.....	1.216			79.....	5.43
				97.5...	9.97

SOLUBILITY OF SULFUR (S_μ) IN CARBON DISULFIDE AND CARBON
TETRACHLORIDE.
(Wigand, 1910.)

When "insoluble" sulfur (S_μ) is treated with CS₂ or CCl₄, a small amount dissolves, depending upon the length of time of contact, temperature and nature of the solvent but not on the relative amount of solvent. This action is explained on the assumption that a partial transformation of S_μ to soluble sulfur S_λ, takes place.

Data for the fusion points of mixtures of rhombic sulfur and "insoluble" sulfur (S_μ) and for monoclinic sulfur and "insoluble" sulfur (S_μ) are given by Kruyt (1908).

SOLUBILITY OF SULFUR IN CARBON DISULFIDE.

(Etard, 1894; Cossa, 1865; at 10°, Retgers, 1893; below 77°, Arcowski, 1895-96.)

t°.	Gms. S per 100 Gms. Solution. CS ₂		t°.	Gms. S per 100 Gms. Solution. CS ₂		t°.	Gms. S per 100 Gms. Solution. CS ₂	
-110	3.0	3.1	-10	13.5	15.6	50	59.0	143.9
-100	3.5	3.6	0	18.0	22.0	60	66.0	194.1
-80	4.0	4.2	10	23.0*	29.9	70	72.0	257.1
-60	3.5	3.6	20	29.5	41.8	80	79.0	376.1
-40	6.0	6.4	25	33.5	50.4	90	86.0	614.1
-20	10.5	11.7	30	38.0	61.3	100	92.0	1150.0
			40	50.0	100.0			

* 26.4 R.

Sp. Gr. of solution saturated at 15° containing 26 gms. S per 100 gms. solution = 1.372.

The following determinations upon this system were made by Hammik, Cousnes and Langford, 1928, by the method of chilling liquified sulfur.

t°	Percent S ₈ dissolved by CS ₂	t°	Percent S ₈ dissolved by CS ₂	t°	Percent S ₈ dissolved by CS ₂
155	4.3	196	35.0	260	38.6
160	9.1	210	38.7	263	37.7
170	18.4	213	38.8	271	39.9
175	22.7	223	37.1	279	37.9
178	23.5	227	39.0	280	39.3
186	28.7	229	40.7	287	39.9
240	33.9*	242	39.6	271	35.9*
245	34.2*	260	33.7*	290	33.2*
254	30.8*	261	32.6*	299	31.7*
		266	34.8*		

* In these cases the droplets of sulfur were graded as fair, in all other cases, as good.

SOLUBILITY OF OCTOHEDRAL AND OF PRISMATIC SULFUR IN SEVERAL SOLVENTS. (Brönsted, 1906.)

The solubility of prismatic sulfur could not be determined in the ordinary way on account of its rapid transition to octohedral sulfur. A special apparatus was used which permitted the solvent to remain in contact with the solid for only a short time. Since sulfur dissolves very rapidly, this procedure was found to give satisfactory results.

Solvent.	t°.	Gms. each Variety Separately per 100 cc. Saturated Solution.	
		Prismatic Sulfur.	Octohedral Sulfur.
Benzene	18.6	2.004	1.512
"	25.3	2.335	1.835
Chloroform	0	1.101	0.788
"	15.5	1.658	1.253
"	40	2.9	2.4
Ethyl Ether	0	0.113	0.080
"	25.3	0.253	0.200
Ethyl Bromide	0	0.852	0.611
"	25.3	1.676	1.307
Ethyl Formate	0	0.028	0.019
Ethyl Alcohol	25.3	0.066	0.052

SOLUBILITY OF SULFUR IN SEVERAL SOLVENTS.

Solvent.	t°.	Gms. S per 100 Gms. Solvent.	Solvent.	t°.	Gms. S per 100 Gms. Solvent.
Aniline	130	85.3 (1)	Glycerol	15.5	0.14 (4)
Benzene	15.2	1.5 (2)	Hydrazine (anhy.)	room temp.	54 (decomp.) (5)
"	19.3	1.7 (2)	Lanoline (anhy.)	45	0.38 (6)
"	26	0.97 (1)	Methylene Iodide	10	10 (7)
"	71	4.38 (1)	Nicotine	100	10.6 (8)
Carbon Tetrachloride	25	0.86 (3)	Phenol	174	16.4 (1)
Chloroform	12.2	0.75 (2)	Pentachlor Ethane	25	1.2 (3)
"	19.3	0.92 (2)	Toluene	23	1.48 (1)
"	22	1.21 (1)	Tetrachlor Ethane	25	1.23 (3)
Dichlor Ethylene	25	1.28 (3)	Tetrachlor Ethylene	25	1.53 (3)
Ethylene Chloride	25	0.84 (3)	Trichlor Ethylene	25	1.63 (3)
Ethyl Ether	23.5	0.97 (1)	"	15	1.16 (9)

(1) Cossa, 1868; (2) Brönsted, 1906; (3) Hoffman, Kirmreuther and Thal, 1910; (4) Ossendowski, 1907; (5) Welsh and Broderson, 1915; (6) Klose, 1907; (7) Retgers, 1893; (8) Kleven, 1872; (9) Wester and Bruins, 1914.

SOLUBILITY OF SULFUR IN BENZENE, IN BENZINE AND IN BROMOFORM.

Solvent.	t°.	Gms. S per 100 gms. sat. solution.	Authority.
Benzene	25	2.074	Hildebrand and Jenks, 1921.
"	54	5.165	"
"	84	13.02	"
Benzine.....	15	1.56	Delaplace, 1922.
"	20	1.96	"
Bromoform.....	5.6	3.64	Amadori, 1922.

Additional results for the system Sulfur + Bromoform are given by Rheinboldt and Schneider, 1929.

RECIPROCAL SOLUBILITY OF SULFUR AND BENZENE, DETERMINED BY THE SYNTHETIC METHOD.

(Alexejew, 1886.)

t°.	Gms. C ₆ H ₆ per 100 Gms.		t°.	Gms. C ₆ H ₆ per 100 Gms.	
	S Layer.	C ₆ H ₆ Layer.		S Layer.	C ₆ H ₆ Layer.
100	6	75	140	16	61
110	8	72.5	150	19	55
120	10	70	160	25	45
130	12	66	164 (crit. temp.)	35	

(Kruyt, 1908-09.)

Wt. % S in Mixture.	Limiting t° of Homogeneity.		Wt. % S in Mixture.	Limiting t° of Homogeneity.	
	Lower.	Upper.		Lower.	Upper.
41.5	146	247	79.8	141	230
55.2	158	230	81.4	138	above 246
74.5	157	226	83.4	131	" 272

100 gms. sat. solution of S in benzoyl chloride, C₆H₅.COCl, contain 1 gm. S at 0° and 55.8 gms. at 134°.

(Bogousky, 1905.)

SOLUBILITY OF SULFUR IN BENZENE AND IN ETHYLENE DIBROMIDE.

(Etard, 1894; see also Cossa, 1863.)

In C ₆ H ₆ .				In C ₂ H ₄ Br ₂ .			
t°. per	Gms. S 100 Gms. Solution.	t°.	Gms. S per 100 Gms. Solution.	t°.	Gms. S per 100 Gms. Solution.	t°.	Gms. S per 100 Gms. Solution.
0	1.0	70	8.0	0	1.2	50	6.4
10	1.3	80	10.5	10	1.7	60	8.4
20	1.7	90	13.8	20	2.3	70	11.4
25	2.1	100	17.5	25	2.8	80	16.5
30	2.4	110	23.0	30	3.3	90	24.0
40	3.2	120	29.0	40	4.4	100	36.5
50	4.3	130	36.0				
60	6.0						

SOLUBILITY OF SULFUR IN BENZENE, ACETIC ACID AND THEIR MIXTURES.

(Anders, 1933.)

t°	Wt. % CH ₃ COOH in C ₆ H ₆ Solvent	Gms. S per 100 gms. sat. sol.	t°	Wt. % CH ₃ COOH in C ₆ H ₆ Solvent	Gms. S per 100 gms. sat. sol.
0	39.86	0.307	30	0.0	2.019
20	0.0	1.768	30	37.76	0.603
20	37.57	0.541	30	67.76	0.186
20	70.78	0.156	30	100.0	0.037
20	100.00	0.032			

RECIPROCAL SOLUBILITY OF PARA DICHLORO BENZENE AND SULFUR.

(Bruni and Pelizzola, 1921.)

Initial temp. of cryst.	Gms. C ₆ H ₄ Cl ₂ p per 100 gms. mixture.	Initial temp. of cryst.	Gms. C ₆ H ₄ Cl ₂ p per 100 gms. mixture.	Initial temp. of cryst.	Gms. C ₆ H ₄ Cl ₂ p per 100 gms. mixture.
52.9.....	100.0	79.6.....	85	96.5.....	40
52.6.....	99	86.6.....	80	97.4.....	30
52.2.....	97	94.6.....	70	98.4.....	25
51.0 (Eutec.)..	—	97.1.....	60	99.05.....	20
51.5.....	95	96.8.....	55	101.4.....	10
67.8.....	90	96.9.....	50	107.2.....	5
				113.....	0 (=pure S)

Data for equilibrium in the system Sulfur + Benzoic Acid are given by Hammick and Holt, 1927.

S

SOLUBILITY OF SULFUR IN PHENOL, DETERMINED BY THE SYNTHETIC METHOD.

(Smith, Holmes and Hall, 1905.)

The mixtures of sulfur and phenol were heated until they were homogeneous and then cooled to the temperature at which clouding appeared.

t° of Clouding.	Gms. S per 100 Gms. Phenol.	t° of Clouding.	Gms. S per 100 Gms. Phenol.	t° of Clouding.	Gms. S per 100 Gms. Phenol.
89.5	9.1	155	26.3	166	31.6
96.5	10.4	157.5	27.1	167.5	32.4
122.5	15.3	160.5	28.6	170	33.5
138	19.9	162	29.6	172	34.9
148.5	23.6	164.5	30.7	175	36.5

RECIPROCAL SOLUBILITY OF SULFUR AND TOLUENE, DETERMINED BY THE SYNTHETIC METHOD.

(Kruyt, 1908-09.)

Wt. % S in Mixture.	Limiting t° of Homogeneity.		Wt. % S in Mixture.	Limiting t° of Homogeneity.	
	Lower.	Upper.		Lower.	Upper.
50.5	167	250	75.7	178	221
62	179	223	77.9	174	...
69.6	180	222	83.3	160	223
73	180	222	90.5	124	above 250

SOLUBILITY OF SULFUR (S_{π}) IN TOLUENE AT 0° AND AT 25° .
(Aten, 1913.)

Comp. of Mixture in Atom Per cent S.	Solubility in Atom % S.		Comp. of Mixture in Atom Per cent S.	Solubility in Atom % S.	
	At 0° .	At 25° .		At 0° .	At 25° .
35	2.88	5.94	74	4.05	7.52
47	...	6.65	77	3.90	...
54	3.26	6.76	80	4.22	...
57	3.30	6.88	83	...	7.93
73	...	7.45	85	...	8.08

These results show that the greater the excess of S_{π} , the greater the solubility. It was found that under the same conditions, unchanged rhombic sulfur gives constant figures irrespective of the excess of S present. At 0° , 2.59 atom per cent S_{λ} was found and at 25° , 5.65 atom per cent.

SOLUBILITY OF SULFUR IN TOLUENE.
(Jacek, 1926; Delaplace, 1922; Hildebrand and Jenks, 1921.)

t°.	Gms. S per 100 gms. sat. sol.		t°.	Gms. S per 100 gms. sat. sol.		t°.	Gms. S per 100 gms. sat. sol.	
	per 100 gms. sat. sol.			per 100 gms. sat. sol.			per 100 gms. sat. sol.	
-58.25...	0.079 (J)		-16.0...	0.480 (J)		20...	1.827 (D)	
-40.25...	0.169 »		-10.....	0.576 »		23...	1.889 »	
-33.75...	0.214 »		0.....	0.923 »		25...	2.018 (H and J)	
-28.50...	0.296 »		0.....	0.897 (H and J)		35...	2.722 »	
-21.0....	0.380 »		13.....	1.515 (D)		54...	4.85 »	
-17.75...	0.437 »		15.5...	1.649 (J)		83.5.	11.64 »	

Experiments by Aten, 1918, showed that when rhombic sulfur is heated in sulfur chloride or toluene solutions, its solubility is increased, due to the transformation of rhombic sulfur to another form, S_{π} . This is accompanied by a change in the color of the solution. The increase in solubility is greater the more concentrated the original solution. The author studied the influence of temperature and of concentration, upon the transformation of sulfur dissolved in toluene. The mixtures containing different concentrations of sulfur, were heated respectively for 6 hours at 140° , 4 hours at 150° and 2 hours at 160° . They were cooled and the amount of sulfur remaining in solution after addition of a small quantity of rhombic sulfur and stirring for one hour at 0° was determined.

Mixtures heated at 140° .		Mixtures heated at 150° .		Mixtures heated at 160° .	
% concentration of original solution.	Gms. S per 100 gms. sat. sol. at 0° .	% concentration of original solution.	Gms. S per 100 gms. sat. sol. at 0° .	% concentration of original solution.	Gms. S per 100 gms. sat. sol. at 0° .
3.4	1.18	3.6	1.24	3.2	1.24
6.2	1.42	6.6	1.50	6.2	1.54
9.2	1.64	10.6	1.79	15.0	2.40
22.0	2.69	22.6	2.96	21.6	3.00
27.6	3.23	30.1	3.54	30.0	3.64

The quantity of S_{π} formed in CS_2 solutions is about equal to that formed in toluene and is much smaller than the quantity formed in sulfur chloride solutions.

SOLUBILITY OF SULFUR IN PYRIDINE. (Hammick and Holt, 1926.)

The temperature of weighed mixtures of the constituents, contained in sealed tubes, was raised or lowered untill the point was reached at which the sulfur phase increased or diminished. The observations of the end point were accurate to 0.3-0.5.

Solid-Liquid Equilibria.

t°.	Wt. % S.	Solid Phase.
84.5 ..	10.5	Rhombic S
91.5...	13.35	"
95.2...	15.9	"
97.5...	16.9	"
101....	19.2	Monoclinic S
110.....	98.0	"

Liquid-Liquid Equilibria.

t°.	Wt. % S.	t°.	Wt. % S.
About 80..	13.35	160.5...	59.0
98.0...	19.2	161.0...	70.0
116.0...	24.65	156.0...	79.7
127.5...	29.8	147.0...	87.78
144.0...	38.8	132.5...	88.4
157.0...	50.7	137.0...	90.0
		127.0...	91.94

100 gms. Pyridine dissolve 1.5 gm. S at about 20° and 63.0 gms. at the b. pt. (Le fevre, 1932.)

SOLUBILITY OF SULFUR IN QUINOLINE. (Hammick and Holt, 1926.)

The determinations were made as described above.

Solid-Liquid Equilibria.

Rhombic Sulfur. Monoclinic Sulfur.

t°.	Wt. % S.	t°.	Wt. % S.
74.5...	13.8	88.75...	24.0
85.8...	19.8	91.0....	25.9
93.2...	25.9	96.0....	32.8
93.8...	27.35	97.1....	35.8
94.2...	28.7	98.5....	39.0
94.6...	30.4	99.2....	41.9
96.5...	32.8	100.9....	45.4
96.0...	32.95	101.1....	49.5
98.5...	41.9	101.4....	57.0
99.5...	49.5	101.8....	66.75
99.5...	49.7	102.0....	73.8
100.0...	65.3	102.3....	79.0
101.0...	85.5	104.7....	90.4
		111.5....	97.8

Liquid-Liquid Equilibria (Metastable).

(The mixtures were cooled without being seeded with Sulfur.)

t°.	Wt. % S.	t°.	Wt. % S.
60.0...	27.35	94.8....	57.0
72.6...	32.8	95.2....	60.9
78.0...	35.8	96.0....	65.3
82.5...	39.0	95.5-96.2...	66.3
85.0...	41.5	96.5....	66.75
85.5...	41.9	94.8....	73.8
89.2...	45.4	93.9....	79.0
90.2...	46.8	92.6....	79.8
91.6...	49.5	91.9....	80.5
91.6...	49.7	85.4....	85.2
94.3...	55.4	70.0....	90.4
94.5...	55.5		

RECIPROCAL SOLUBILITY OF SULFUR AND META XYLENE, DETERMINED BY THE SYNTHETIC METHOD.

(Kruyt, 1908-09.)

Wt. % S in Mixture.	Limiting t° of Homogeneity.		Wt. % S in Mixture.	Limiting t° of Homogeneity.	
	Lower.	Upper.		Lower.	Upper.
50.9	181	213	39.9	152	none (230)
49.1	177	228	84.2	none	"
47.7	172.5	none (?)	86.1	164.5	199
44.2	161.5	" (255)	87	159	202.5
40.4	153.5	" (215)	90	139	none (220)

SOLUBILITY OF SULFUR IN META XYLENE. (Hildebrand and Jenks, 1921.)

t°.....	25.	45.	80.
Gms. S per 100 gms. sat. sol.....	1.969	3.604	10.29

SOLUBILITY OF SULFUR IN PARA XYLENE. (Hammick and Holt, 1926.)

Results for the
Solid-Liquid Equilibria.

t°.	Gms. S per 100 gms. sat. sol.	Solid Phase.
92.5...	13.95	Rhombe S
100.5...	17.85	"
85.0...	11.0	"
107.0...	21.8	Monoclinic S
98.2...	16.25	"
98.0...	16.3	"
106.0...	20.38	"
103.3...	17.85	"

Results for the
Liquid-Liquid Equilibria.

t ₁ - t ₂ .	Gms. S per 100 gms. sat. sol.	t ₁ - t ₂ .	Gms. S per 100 gms. sat. sol.	t ₁ - t ₂ .	Gms. S per 100 gms. sat. sol.
about 80...	16.25	149-150...	34.9	184.....	81.0
94.....	20.38	158-165...	39.9	175.....	85.6
101-109...	21.8	167-174 ⁽²³⁵⁾	44.0	156.....	85.5
117-121...	25.9	171-179...	45.7	162-177 ⁽¹⁸⁷⁾	87.9
124-129...	27.95	175-183 ⁽²²⁰⁾	46.3	150-155 ⁽²⁰³⁾	90.0
130-134...	30.22	175-196 ⁽²⁰⁶⁾	48.3	143-147 ⁽²⁰⁵⁾	91.0
137-141...	31.95	190.....	61.7	84....	96.2
144-148...	34.6	190.....	71.2		

t₁ is the temperature at which the second liquid phase first dissolves.

t₂ is the temperature at which the second liquid phase finally dissolves.

The figures in parentheses show the temperatures at which mixtures that have become homogeneous at lower temperatures again separate into two liquid layers.

SOLUBILITY OF SULFUR IN HEXANE (C₆H₁₄).
(Etard.)

t°.	Gms. S per 100 Gms. Solution.	t°.	Gms. S per 100 Gms. Solution.	t°.	Gms. S per 100 Gms. Solution.
-20	0.07	60	1.0	130	5.2
0	0.16	80	1.7	140	6.0
20	0.25	100	2.8	160	7.2
40	0.55	120	4.4	180	8.2

SOLUBILITY OF SULFUR (S_x) IN β NAPHTHOL, DETERMINED BY THE
SYNTHETIC METHOD.

(Smith, Holmes and Hall, 1905.)

The mixtures of sulfur and β naphthol were heated until they were homogeneous and then cooled to the temperature at which clouding appeared.

t° of Clouding.	Gms. S per 100 Gms. β Naphthol.	t° of Clouding.	Gms. S per 100 Gms. β Naphthol.	t° of Clouding.	Gms. S per 100 Gms. β Naphthol.
118	34	154	84.1	164	209.7
132.5	46.6	157	97.4	163.8	238.1
134.5	48.8	160.5	119.3	163.8	264.8*
143.5	59.3	162.5	145.1	163	300 *
149.5	70	163.5	177.6		

* Solid phase, β naphthol.

SOLUBILITY OF SULFUR IN HEPTANE.

(Hildebrand and Jenks, 1921.)

t°.....	0.	25.	35.	45.	54.
Gms. S per 100 gms. sat. sol. ...	0.124	0.362	0.512	0.698	0.926

SOLUBILITY OF SULFUR IN RAIL ROAD LIGHT OIL.

(Thompson and Odeen, 1920.)

t°.....	0.	24.	28.
Gms. per 100 cc. sat. sol.	0.198	0.324	0.364

Results are given for equilibrium in the following systems.

S + CHI ₃ (Iodoform) (1)	S + CO(NH ₂) ₂ (Urea) (4)
S + CH ₂ I ₂ (Methylene Iodide) (1)	S + NH ₂ COOC ₂ H ₅ (Ethyl Urethan) (4)
S + C ₂ I ₄ (Tetra iodo ethylene) (1)	S + C ₆ H ₄ (OH) ₂ (Hydroquinone) (4)
S + C ₂ H ₂ I ₂ (Di iodo ethylene) (1)	S + C ₆ H ₄ OHCO ₂ C ₆ H ₅ (Salol) (4)
S + C ₂ I ₂ (Di iodo acetylene) (1)	S + C ₆ H ₄ (OH) ₂ (m) (Resorcinol + αC ₆ H ₅) (5)
S + C ₂ H ₂ I ₂ (1.2 Di iodo ethane) (1)	S + αNaphthalamine (5)
S + C ₂ Br ₄ (Tetra brom ethylene) (1)	S + C ₆ H ₅ NHCOCH ₃ (Acetanilid) (4)
S + C ₂ NO ₂ I ₃ (Tri iodo nitro ethylene) (1)	S + αC ₁₀ H ₇ (αNaphthylamine) (4)
S + [(C ₆ H ₅) ₂ I] ₃ (Di phenyl iodonium tri iodide) (1)	S + C ₁₀ H ₁₃ NO ₂ (Phenacetin) (4)
S + C ₆ H ₄ I ₂ (Di iodo benzene) (1)	S + C ₁₀ H ₂₀ O (Menthol) (4)
S + C ₆ H ₄ Cl ₂ (p Di chlor benzene) (2)	S + C ₁₁ H ₁₂ N ₂ O (Antipyrine) (4)
S + C ₄ H ₈ Cl ₂ S (Di-2-chlor ethyl sulfide) (3)	S + C ₂₀ H ₂₄ N ₂ O ₂ (Quinine) (4)

(1) Rheinboldt and Schneider, 1929; (2) Bruni and Pelizzola, 1921; (3) Wilkinson, Neilson & Wylde, 1920; (4) Hrynakowski and Adamansis, 1934.; (5) Hrynakowski, Staszeroski and Sziintz, 1937.

SOLUBILITY OF SULFUR IN COAL TAR OIL, LINSEED OIL AND IN OLIVE OIL.
(Pelouze, 1869; Pohl.)

°.	Grams S per 100 Grams Coal Tar Oil of:						G. S per 100 Gms.	
	Sp. Gr.: 0.87 b. pt.: 80°-100°.	0.88 85°-120°.	0.882 120°-220°.	0.885 150°-200°.	1.01 210°-300°.	1.02 220°-300°.	Linseed Oil.	Olive Oil of 0.885 Sp. Gr
15	2.1	2.3	2.5	2.6	6.0	7.0	0.4	2.3
30	3.0	4.0	5.3	5.8	8.5	8.5	0.6	4.3
50	5.2	6.1	8.3	8.7	10.0	12.0	1.2	9.0
80	11.8	13.7	15.2	21.0	37.0	41.0	2.2	18.0
100	15.2	18.7	23.0	26.4	52.5	54.0	3.0	25.0
110	...	23.0	26.2	31.0	105.0	115.0	3.5	30.0
120	...	27.0	32.0	38.0	∞	∞	4.2	37.0
130	...	...	38.7	43.8	∞	∞	5.0	43.0
						(160°)	10.0	

S

100 gms. oil of turpentine dissolve 1.35 gms. S at 16°, and 16.2 gms. at b. pt.
(Payen, 1852.)

SOLUBILITY OF SULFUR IN RUBBER.
(Venable and Greene, 1922.)

Thin strips of rubber stock, which had been compounded with 0 to 20 per cent of sulfur, were packed in flowers of sulfur and kept at desired temperatures until equilibrium was established. The samples were then analyzed for free and combined sulfur. Equilibrium was approached from above and below, and was reached fairly quickly from below but from above, little of any of the excess sulfur migrated to the outside of the sheet. Consequently all the samples were given a preliminary heating to insure complete solution of the crystals before being placed in the pack. The results are given only in the form of curves and from these, the following approximate values were read. They show that the solubility increases as a « straight line function of the amount of combined sulfure up to a vulcanisation coefficient of about 7 ».

Per cent combined Sulfur.	Per cent free Sulfur at		
	55°.	75°.	95°.
1.0.....	2.8	4.8	7.1
3.0.....	2.9	5.2	8.1

SOLUBILITY OF SULFUR IN RUBBER.

(Morris, 1932.)

Mixtures of weighed amounts of pale crepe uncured rubber and sulfur were prepared in a laboratory mill and thin sheets of these were mounted between microscope slides and kept at controlled temperatures. Observation of these sheets by transmitted light with the aid of a microscope were made at a series of temperatures, and the point ascertained at which the solubility of the sulfur in the rubber is complete. The results are given in the form of a small diagram from which the following approximate values were read.

t°	Gms. S per 100 gms. rubber	t°	Gms. S per 100 gms. rubber
30	0.8	70	2.9
40	1.2	80	3.6
50	1.7	90	4.7
60	2.3	100	6.0

DISTRIBUTION OF SULFUR BETWEEN RUBBER AND AMYL ALCOHOL AND BETWEEN
RUBBER AND *n* BUTYL ALCOHOL.
(Kelly and Ayers, 1924.)

The determinations were made by two methods: (1) The sulfur was mixed with rubber and the mixture kept in contact with amyl alcohol. After attainment of equilibrium the sulfur in the amyl alcohol was determined. (2) The rubber was kept in contact with *n* butyl alcohol saturated with sulfur, and after attainment of equilibrium, the sulfur in the *n* butyl alcohol was determined.

Results for Rubber and Amyl Alcohol
by method (1) and at 40°.

Per cent S in original S + Rubber mixture.	Distribution of Sulfur Gms. S per 100 gms.		
	Amyl alcohol (C_1).	Rubber (C_2).	$\frac{C_2}{C_1}$
0.42	0.0395	0.336	8.50
0.42	0.0395	0.342	8.68
0.80	0.0466	0.536	11.5
0.80	0.0455	0.556	12.5
0.95	0.0497	0.570	11.5
0.95	0.0499	0.592	11.8
1.21	0.0681	0.729	11.7
1.41	0.0783	0.850	10.7

Results for Rubber and *n* Butyl
Alcohol by method (2) and at 30°.

Gms. Rubber per 100 cc. Butyl alc. sat. with S.	Distribution of Sulfur Gms. S per 100 gms.		
	Butyl alcohol (C_1).	Rubber (C_2).	$\frac{C_2}{C_1}$
2	0.168	0.840	5.0
4	0.148	0.79	5.3
6	0.136	0.72	5.3
8	0.123	0.67	5.4
10	0.109	0.64	5.9
12	0.106	0.55	5.2
14	0.098	0.52	5.3

The solubility of sulfur in *n* butyl alcohol at 30° was found to be 0.187 gm. S per 100 gms. alcohol. Assuming that the same ratio holds at saturation as that found by the distribution experiments, the solubility of sulfur in rubber was calculated to be $(0.187 \times 5.4 =) 1.01$ gm. S per 100 gms. rubber at 30°.

A series of experiments made by suspending slabs of rubber, having different coefficients of vulcanisation, in *n* butyl alcohol saturated with sulfur, and stirring gently, gave results for the solubility which increased linearly with the coefficient of vulcanisation up to a value of 17. This corresponds to the point where about 35 per cent of the double bonds of the rubber are saturated with sulfur. The results show that rubber dissolves but does not adsorb sulfur.

Fusion-point data are given for:

- S + Sb (Pelabon, 1909; Jaeger, 1911; Guertier and Schack, 1923.)
 S + Se (Matsumoto, 1916.)
 S + Sn (Pelabon, 1909.)
 S + Te (Pelabon, 1909; Pellini, 1909; Chikashige, 1911, 1911-2;
 Jaeger and Menke, 1912; Losana, 1923.)
 S + Pb; S + Ag; S + Au; S + As (Pelabon, 1909.)

SULFUR Mono BROMIDE S_2Br_2 .

Fusion-point data are given for S_2Br_2 + $SbBr_3$ and S_2Br_2 + $SnBr_4$ by Pusin and Makuc, 1938.

SULFUR NITRIDE S_4N_4 .

SOLUBILITY OF SULFUR NITRIDE IN SEVERAL SOLVENTS.

(Voanesenski, 1927.)

t°	Gms. S_4N_4 per 1000 cc of:		
	CS_2	C_6H_6	C_2H_5OH
0	3.705	2.266	0.645
10	6.845	4.260	0.830
20	9.391	6.301	1.050
30	13.188	8.692	1.271
40	16.887 (?)	11.107	1.478
50	—	13.721	1.640
60	—	17.100	—

N

SULFUR DIOXIDE SO_2

SOLUBILITY IN WATER.

(Schönfeld, 1855; Sims, 1861; Roozeboom, 1884.)

Schönfeld.				Sims.			Roozeboom.	
t°.	Vols. SO_2 (at 0° and 760 mm.) per 1 Vol.		Gms. SO_2 per 100 Gms. H_2O at total pressure 760 mm.	t°.	SO_2 per 1 Gm. H_2O .		t°.	SO_2 Dissolved per 1 pt. H_2O at 760 mm. pressure.
	Sat. SO_2 + Aq.	H_2O .			Gms.	Vols.		
0	68.86	79.79	22.83	8	0.168	58.7	0	0.236
5	59.82	67.48	19.31	10	0.154	53.9	2	0.218
10	51.38	56.65	16.21	14	0.130	45.6	4	0.201
15	43.56	47.28	13.54	20	0.104	36.4	6	0.184
20	36.21	39.37	11.29	26	0.087	30.5	7	0.176
25	30.77	32.79	9.41	30	0.078	27.3	8	0.168
30	25.82	27.16	7.81	36	0.065	22.8	10	0.154
35	21.23	22.49	...	40	0.058	20.4		
40	17.01	18.77	5.41	46	0.050	17.4	12	0.142
				50	0.045	15.6		

O

Sp. Gr. of sat. solution at 0° = 1.061; at 10°, 1.055; at 20° = 1.024.

The results of Sims are discussed and recalculated by Fulda, 1909.

1 gm. H_2O dissolves 0.0909 gm. SO_2 = 34.73 cc. (measured at 25°) at 25° and 760 mm. pressure.

(Walden and Centnerszwer, 1902-03.)

FREEZING-POINT DATA FOR THE SYSTEM SULFUR DIOXIDE — WATER.
(Baume and Tykociner, 1914.)

t° of Freezing.	Mols. SO ₂ per 100 Mols. SO ₂ +H ₂ O.	Solid Phase.	t° of Freezing.	Mols. SO ₂ per 100 Mols. SO ₂ +H ₂ O.	Solid Phase.
0	0	Ice	7.7	5.1	SO ₂ Hydrate
-0.2	0.8	"	8.3	5.9	"
-3 Eutec.	...	" +SO ₂ Hydrate	9.3	7.1	"
-0.2	2.8	SO ₂ Hydrate	12.1	11	"
+3.5	3.3	"	:	:	:
6.8	5.5	"	12.2	95.1	"

At the temperature +12.1° and extending over the range of concentration 11 to 95.1 mols. per cent SO₂ a second phase rich in SO₂ separates. This crystallizes at -74° and the diagram is consequently composed of two lines parallel to the axis of concentration, the one at the +12.1° level corresponding to the SO₂ hydrate, and the other at the -74° level, to the SO₂ rich phase. The diagram is terminated by a very short branch rising from -74° to the temperature of solidification of pure SO₂ (-72.3°).

More recent determinations of the equilibrium in the system SO₂ + H₂O, made by the synthetic method, are described by Terres and Rühl, 1934. A hitherto unrecognized second modification of solid SO₂ was obtained. Its formation is apparently caused by traces of H₂O. Its melting point is -63.5° instead of 71° the m.pt. of the ordinary form of solid SO₂. The numerical results of the determinations are given only in the complete report of the work published. Beihefte zu den Zeitschriften des Vereins deutscher Chemiker No. 8, 1934, Verlag chemie Berlin W35 Cornelius Str. 3.

SOLUBILITY OF SULFUR DIOXIDE IN WATER AT DIFFERENT PRESSURES.
(Lindner, 1912.)

Results at 0°.		Results at 25°.		Results at 50°.	
Pressure in mm. Hg.	Gms. SO ₂ per 100 cc. Sat. Sol.	Pressure in mm. Hg.	Gms. SO ₂ per 100 cc Sat. Sol.	Pressure in mm. Hg.	Gms. SO ₂ per 100 cc. Sat. Sol.
0.4	0.0537	1.4	0.0534	4.9	0.0525
3.5	0.237	11.75	0.234	30.5	0.2276
29.4	1.227	87.9	1.212	204.5	1.181
109.4	3.804	313	3.750	696	3.628

SOLUBILITY OF SULFUR DIOXIDE IN WATER AT LOW PARTIAL PRESSURES.

Results of

Conrad and Benschlein, 1934

Johnstone and Leppla, 1934.

at 25°		at 25°		at 35°		at 50°	
P mm	Gms. SO ₂ per 100 gms. H ₂ O	P mm	Gm. Mols. SO ₂ at. per 1000 gms. H ₂ O	P mm	Gm. Mols. SO ₂ at. per 1000 gms. H ₂ O	P mm	Gm. Mols. SO ₂ at. per 1000 gms. H ₂ O
299	3.63	0.00027	0.002484	0.00103	0.00419	0.00230	0.00467
308	3.72	0.00120	0.006203	0.00249	0.00745	0.00383	0.00637
593	6.89	0.00229	0.009546	0.00412	0.00999	0.00538	0.00838
611	6.99	0.00267	0.01084	0.00580	0.01356	0.00879	0.01057
640	7.28	0.00671	0.02059	0.00955	0.01987		
730	8.37	0.00911	0.02561				
		0.01350	0.03328				

P_{mm} = partial pressure of SO₂ in mm. Hg.; that is the total pressure minus the partial pressure of the H₂O.

P_{at.} = partial pressure of SO₂ in atmospheres.

SOLUBILITY OF SULFUR DIOXIDE IN WATER.

Results of Hudson, 1925.

t°.	Gms. SO ₂ (at partial pressure of 760 mm. Hg) per 100 gms. H ₂ O.
10.....	15.39
15.....	12.73
20.....	10.64
29.9.....	7.58
40.....	5.54
48.15.....	4.39
60.....	3.25
70.....	2.61
80.....	2.13
90.....	1.805

Results of Smith and Parkhurst, 1922.

t°.	Pressure of SO ₂ in mm. Hg.	Gms. SO ₂ per 100 cc. H ₂ O.
5.....	474.8	11.55
20.....	198.6	2.97
20.....	224.4	3.34
20.....	366.6	5.22
20.....	1107.8	15.01
40.....	306.4	2.21
40.....	373.8	2.68
60.....	175.7	0.84

The determinations of Hudson were made by bubbling the gas through the solution until saturation was reached. Especial care was taken to obtain accurate results. Attention is called to the sources of error in the determinations of Schönfeld, 1855.

In addition to the above results given by Smith and Parkhurst these authors also determined the solubility of sulfur dioxide in aqueous suspensions of calcium and magnesium hydroxides.

Freese, 1920, gives results for the solubility of sulfur dioxide in water which are identical with those of Schönfeld, 1855.

PARTIAL VAPOR PRESSURES OF AQUEOUS SOLUTIONS OF SULFUR DIOXIDE.
(Sherwood, 1925.)

The author collected the available data on the partial vapor pressure of sulfur dioxide in water and from the plotted results constructed the following table. He assumed that the dissociation is constant at any particular temperature and that Henry's law applies to the undissociated solute. On the basis of this assumption it has been shown (Haslam, Hershey and Keen, *Ind. Eng. Chem*, 16, 1225, 1924)

that $S = H_p + \sqrt{KH_p}$ or $\frac{S}{\sqrt{p}} = H\sqrt{p} + \sqrt{KH}$, when S = gms. SO₂ dissolved in 1000 gms. H₂O; p = partial pressure of SO₂ in mm. Hg; H = Henry's law constant and K = dissociation constant of the H₂SO₃. The results of Schönfeld, Sims, Roozeboom, Lindner, Freeze, Smith and Parkhurst and Watts, were used.

Gms. SO ₂ per 1000 gms. H ₂ O.	Partial pressure of SO ₂ in mm. Hg at							
	0°.	7°.	10°.	15°.	20°.	30°.	40°.	50°.
0.2.....	0.25	0.3	0.3	0.3	0.5	0.6	0.8	1.3
0.5.....	0.6	0.7	0.75	0.8	1.2	1.7	2.8	4.3
1.0.....	1.2	1.5	1.75	2.2	3.2	4.7	7.5	12.0
1.5.....	1.9	2.6	3.1	3.8	5.8	8.1	12.9	20.0
2.0.....	2.8	3.7	4.6	5.7	8.5	11.8	13.3	31.0
3.0.....	5.1	6.9	7.9	10.0	14.1	19.7	57.0	82.0
5.0.....	9.9	13.5	15.6	19.3	26.0	36.0	87.0	116.0
7.0.....	15.2	20.6	23.6	28.0	39.0	52.0	121.0	172.0
10.0.....	23.3	31.0	37.0	44.0	59.0	79.0	186.0	266.0
15.0.....	38.0	51.0	59.0	71.0	92.0	125.0	322.0	458.0
25.0.....	69.0	92.0	105.0	127.0	161.0	216.0	665.0	
50.0.....	148.0	198.0	226.0	270.0	336.0	452.0		
75.0.....	228.0	307.0	349.0	419.0	517.0	688.0		
100.0.....	308.0	417.0	474.0	567.0	698.0			
150.0.....	474.0	637.0	726.0					
200.0.....	646.0	657.0						

SOLUBILITY OF SULFUR DIOXIDE IN AQUEOUS SULFURIC ACID SOLUTIONS.

(Dunn; see also Kolb, 1872.)

t°.	Sp. Gr. of H ₂ SO ₄ Solution.	Approximate Per cent H ₂ SO ₄ .	Coefficient of Absorption.	t°.	Sp. Gr. of H ₂ SO ₄ Solution.	Approximate per cent H ₂ SO ₄ .	Coefficient of Absorption
6.9	1.139	20	48.67	15.2	1.173	25	31.82
6.9	1.300	40	45.38	16.8	1.151	21	31.56
8.6	1.482	58	39.91	14.8	1.277	36	30.41
9.8	1.703	78	29.03	15.1	1.458	56	29.87
5.5	1.067	10	36.78	15.6	1.609	70	25.17
6.0	1.102	15	3.408	15.0	1.739	81	20.83

For definition of Coefficient of Absorption, see p. 1136

SOLUBILITY OF SULFUR DIOXIDE IN AQUEOUS
SOLUTIONS OF SULFURIC ACID AT 25°.

(Johnstone and Leppa, 1934.)

Partial pressure of SO ₂ in Atmospheres	Gm. Mols. per 1000 gms. H ₂ O		Partial pressure of SO ₂ in Atmospheres	Gm. Mols. per 1000 gms. H ₂ O	
	H ₂ SO ₄	SO ₂		H ₂ SO ₄	SO ₂
0.00130	0.0879	0.00193	0.00571	0.5174	0.00796
0.00571	0.0879	0.01129	0.01022	0.5174	0.01345
0.01022	0.0879	0.01878	0.00130	1.103	0.00134
0.00130	0.5174	0.00161	0.00573	1.103	0.00719
			0.01022	1.103	0.01253

SOLUBILITY OF SULFUR DIOXIDE IN AQUEOUS SOLUTIONS OF
SULFURIC ACID AT 760mm.

(Oupr, 1926, 1928.)

Results at 41°

Results at 62°

Percent H ₂ SO ₄ in Solvent	Gms. SO ₂ per 100 gms. solvent	cc SO ₂ per 1 cc sat. sol.	Percent H ₂ SO ₄ in Solvent	Gms. SO ₂ per 100 gms. solvent	cc SO ₂ per 1 cc sat. sol.
0	4.81	16.7	0.0	2.15	7.37
7.32	3.65	13.3	10	1.71	6.28
18.02	3.35	12.8	30.26	1.26	5.25
44.34	2.57	11.9	54.06	1.20	5.90
71.86	1.68	9.47	79.07	1.19	6.95
86.20	1.36	8.40	84.34	1.15	6.95
93.28	1.81	11.5	90.73	1.19	7.36
97.69	2.15	13.6	93.68	1.16	7.26
			96.10	1.16	7.29

SOLUBILITY OF SULFUR DIOXIDE IN SULFURIC ACID OF 1.84 SP. GR.

Interpolated from original results.

(Dunn, 1882.)

t°.	Sp. Gr. of Sat. Solution.	Coefficient of Absorp- tion (760 mm.).	t°.	Sp. Gr. of Sat. Solution.	Coefficient of Absorp- tion (760 mm.).
0	...	53.0	50	1.8186	9.5
10	1.8232	35.0	60	1.8165	7.0
20	1.8225	25.0	70	1.8140	5.5
25	1.8221	21.0	80	1.8112	4.5
30	1.8216	18.0	90	1.8080	4.0
40	1.8205	13.0			

SOLUBILITY OF SULFUR DIOXIDE IN CONCENTRATED AQUEOUS SOLUTIONS
OF SULFURIC ACID AT 20°. (Miles and Fenton, 1920.)

The solutions were saturated by means of a stream of SO₂ passing through the actively stirred mixture. The dissolved SO₂ was determined iodometrically.

Per cent H ₂ SO ₄ in acid mixture.	Gms. SO ₂ per 100 gms. acid mixture.	Per cent H ₂ SO ₄ in acid mixture.	Gms. SO ₂ per 100 gms. acid mixture.	Per cent H ₂ SO ₄ in acid mixture.	Gms. SO ₂ per 100 gms. acid mixture.
55.1	5.13	84.2	2.88	94.0	3.31
59.6	4.90	85.3	2.83	94.6	3.50
61.6	4.82	85.8	2.80	95.5	3.69
68.9	4.16	86.5	2.82	95.6	3.77
74.1	3.63	88.1	2.90	96.5	3.83
78.3	3.23	90.8	3.10	98.0	3.98
80.2	3.12	92.8	3.21	98.5	4.03
82.5	2.99	93.7	3.27		

Calculations of the above results showing that the solubility of SO₂ is the sum of its solubility in H₂O and H₂SO₄·H₂O are given by Friend, 1931.

SOLUBILITY OF SULFUR DIOXIDE IN CONCENTRATED SULFURIC ACID.

(Milbauer, 1936.)

Results for H₂SO₄
of d = 1.824 (= 90.8%)

Results for H₂SO₄
of d = 1.53 (= 62.61%)

t°	Gms. SO ₂ per 100 gms. solvent	t°	Gms. SO ₂ per 100 gms. solvent
23	3.075	25	3.1582
30	2.270	45	1.4597
50	1.525	60	1.0200
100	0.436	80	0.5813
150	0.171	100	0.4908

Uncertain results

SOLUBILITY OF SULFUR DIOXIDE IN AQUEOUS SALT SOLUTIONS.
 (Fox, 1902.)

Results in terms of the Ostwald Solubility Expression. See p. 1136

Aqueous Salt Solution.	Solubility Coefficient l of SO_2 in aq. Solutions of Concentrations:					
	0.5 Normal	1.0 N.	1.5 N.	2.0 N.	2.5 N.	3.0 N.
NH_4Cl	$l_{25}=34.58$	36.37	38.06	39.76	41.37	42.78
NH_4Br	$l_{25}=36.25$	39.46	42.78	46.06	49.17	52.25
NH_4CNS	$l_{25}=37.78$	42.74	47.26	52.26	57.01	61.46
NH_4NO_3	$l_{25}=33.96$	35.07	36.28	37.27	38.01	39.14
NH_4NO_3	$l_{35}=23.35$	24.23	24.78	25.57	26.66	27.43
$(\text{NH}_4)_2\text{SO}_4$	$l_{25}=33.35$	33.82	34.33	34.95	35.47	35.96
$(\text{NH}_4)_2\text{SO}_4$	$l_{35}=22.91$	23.14	23.49	23.93	24.23	24.60
CdCl_2	$l_{25}=31.66$	30.55	29.46	28.16	27.09	26.06
CdCl_2	$l_{35}=21.73$	21.23	20.55	20.02	19.23	18.68
CdBr_2	$l_{25}=31.91$	31.01	30.17	29.27	28.15	27.46
CdBr_2	$l_{35}=21.88$	21.46	20.81	20.60	19.70	19.17
CdI_2	$l_{25}=33.27$	33.76	34.16	34.74	34.98	35.77
CdI_2	$l_{35}=22.75$	23.06	23.36	23.71	23.99	24.30
CdSO_4	$l_{25}=31.11$	29.71	28.24	26.58	25.14	23.76
CdSO_4	$l_{35}=21.45$	20.43	19.42	18.31	17.41	16.25
KCl	$l_{25}=34.42$	36.05	37.76	39.32	40.96	42.27
KCl	$l_{35}=23.74$	25.15	26.54	27.94	28.93	30.02
KBr	$l_{25}=35.94$	39.11	42.41	44.96	48.87	52.26
KBr	$l_{35}=24.83$	27.49	29.64	31.93	34.12	36.14
KCNS	$l_{25}=37.57$	42.38	47.02	51.81	55.87	61.26
KCNS	$l_{35}=25.63$	28.79	32.03	35.05	38.13	42.94
KI	$l_{25}=38.66$	44.76	50.58	56.75	62.63	68.36
KI	$l_{35}=26.30$	30.25	34.64	38.04	41.87	45.43
KNO_3	$l_{25}=33.80$	34.79	35.77	36.66	37.57	38.52
KNO_3	$l_{35}=23.27$	24.03	24.79	25.72	26.54	27.33
K_2SO_4	$l_{25}=33.20$	33.61	...	...	...	...
NaBr	$l_{25}=33.76$	34.54	35.27	36.26	36.84	37.74
NaCl	$l_{25}=32.46$	32.25	31.96	31.76	31.51	31.36
NaCNS	$l_{25}=35.44$	38.24	40.78	43.37	45.86	48.34
Na_2SO_4	$l_{25}=31.96$	31.14	30.45	29.51	28.66	28.44
Na_2SO_4	$l_{35}=21.88$	21.35	20.81	20.21	19.75	19.27

The author also gives a series of determinations in which a mixture of $\text{SO}_2 + \text{CO}_2$ is used for saturating the solutions, thus changing the concentration of the SO_2 and yielding results for certain partial pressures of this gas.

Additional data for the solubility of sulfur dioxide in aqueous salt solutions are given by Walden and Centnerszwer (1902-03) but these authors present their results in terms of the difference between the amount of SO_2 dissolved in water and in the aqueous solution. The exact manner in which these calculations were made is not clearly explained.

SOLUBILITY OF SULFUR DIOXIDE IN AQUEOUS SALT SOLUTIONS
AT 25° AND 760mm PRESSURE.
(Bancroft and Gould, 1934.)

Aq. solvents containing 0.5 gm. mol. of the following salts. per liter	Abs. Coef. of SO ₂	Aq. solvents containing 0.5 gm. mol. of the following salts. per liter	Abs. Coef. of SO ₂
H ₂ O alone	32.76	KNO ₃	30.97
Na ₂ SO ₄	29.28	KCl ³	31.53
NaCl	29.74	KBr	32.97
NaBr	30.93	KCNS	34.42
NaCNS	32.47	KI	35.42
K ₂ SO ₄	30.42		

SOLUBILITY OF SULFUR DIOXIDE IN AQUEOUS SOLUTIONS OF POTASSIUM CHLORIDE
AT A PARTIAL PRESSURE OF 760 MM. (Hudson, 1925.)

Gms. per 100 gms. H ₂ O.			Gms. per 100 gms. H ₂ O.			Gms. per 100 gms. H ₂ O.		
t°.	KCl.	SO ₂ .	t°.	KCl.	SO ₂ .	t°.	KCl.	SO ₂ .
10.....	5.55	17.05	29.9...	10.11	8.80	48.15..	32.72	6.18
10.....	10.22	18.58	29.9...	20.82	10.05	60.....	5.30	3.45
10.....	15.85	20.28	29.9...	29.86	11.26	60.....	10.67	3.52
10.....	20.78	21.96	40.0...	5.17	5.96	60.....	21.12	3.92
10.....	29.90	25.40	40.0...	10.20	6.32	60.....	30.98	4.24
15.....	10.39	15.32	40.0...	15.44	6.67 ⁵	70.....	8.74	2.80
15.....	19.91	17.64	40.0...	20.14	7.07	70.....	21.68	3.05
15.....	30.71	20.59	40.0...	24.83	7.45	70.....	30.73	3.26
20.....	5.14	11.62	40.0...	28.95	7.75	80.....	8.66	2.27
20.....	10.30	12.52	48.15..	5.06	4.70	80.....	21.35	2.415
20.....	15.61	13.55	48.15..	10.14	4.945	80.....	29.68	2.52
20.....	24.98	15.38	48.15..	15.82	5.24	90.....	9.23	1.855
20.....	30.38	16.65	48.15..	21.11	5.48	90.....	19.49	1.97
29.9...	5.19	8.21	48.15..	25.09	5.74	90.....	32.75	2.11

SOLUBILITY OF SULFUR DIOXIDE IN AQUEOUS SOLUTIONS OF SODIUM SULFATE
AT A PARTIAL PRESSURE OF 760 MM. (Hudson, 1925.)

Results at 20°.		Results at 30°.		Results at 40°.		Results at 60°.	
Gms. per 100 gms. H ₂ O.		Gms. per 100 gms. H ₂ O.		Gms. per 100 gms. H ₂ O.		Gms. per 100 gms. H ₂ O.	
Na ₂ SO ₄ .	SO ₂ .	Na ₂ SO ₄ .	SO ₂ .	Na ₂ SO ₄ .	SO ₂ .	Na ₂ SO ₄ .	SO ₂ .
0.0	10.64	0.0	7.608	0.0	5.585	0.0	4.214
1.94	10.66	2.04	7.709	2.49	5.812	2.49	4.508
4.93	10.57	3.99	7.776	5.04	5.910	5.04	4.678
7.95	10.36	5.47	7.773	7.95	5.927		
10.00	10.07	7.83	7.716	10.00	5.882	10.04	4.728
15.00	9.66	10.0	7.586	14.94	5.802	14.94	4.730
20.0	9.17	20.0	7.006	20.01	5.630	19.99	4.648

DISTRIBUTION OF SULPHUR DIOXIDE AT 20° BETWEEN:
(McCrae and Wilson, 1903.)

Water and Chloroform.					Aq. HCl and Chloroform.				
Gms. SO ₂ per Liter in:		Gm. Equiv. SO ₂ per Liter in:		Conc. of HCl.	Gms. SO ₂ per Liter in:		Gm. Equiv. SO ₂ per Liter in:		
Aq. Layer.	CHCl ₃ Layer.	Aq. Layer.	CHCl ₃ Layer.		Aq. Layer.	CHCl ₃ Layer.	Aq. Layer.	CHCl ₃ Layer.	
1.738	1.123	0.0543	0.0351	0.05	1.86	1.46	0.0581	0.0456	
1.753	1.122	0.0547	0.0350	"	3.07	2.83	0.0960	0.0884	
2.346	1.703	0.0732	0.0532	"	4.28	4.07	0.1336	0.1271	
2.628	1.897	0.0821	0.0592	"	5.34	5.42	0.1667	0.1692	
3.058	2.385	0.0955	0.0745	0.10	1.25	1.41	0.039	0.044	
3.735	3.062	0.1166	0.0956	"	2.78	3.08	0.0868	0.0962	
4.226	3.626	0.1319	0.1132	"	3.86	4.08	0.1199	0.1275	
5.269	4.798	0.1645	0.1498	"	5.161	5.72	0.1612	0.1784	
6.588	6.183	0.2057	0.1930	0.2	1.268	1.51	0.0396	0.0471	
31.92	33.84	0.9968	1.056	"	1.914	2.27	0.0597	0.0710	
33.26	37.25	1.038	1.163	"	2.464	3.04	0.0769	0.0949	
				"	3.967	4.90	0.1239	0.1530	
				0.4	1.202	1.61	0.038	0.0504	
				"	1.894	2.26	0.059	0.0706	

Freezing-point data for mixtures of sulfur dioxide and sulfuryl chloride (SO₂Cl₂) are given by van der Goot (1913).

SOLUBILITY OF SULFUR DIOXIDE IN ALCOHOLS AND IN OTHER SOLVENTS.
(de Bruyn, 1892; Schulze, 1881.)

t°.	In Ethyl Alcohol at 760 mm.		In Methyl Alcohol at 760 mm.		In Several Solvents at 0° and 725 mm. (S.)		
	Gms. SO ₂ per 100 Gms. Solution.	C ₂ H ₅ OH.	Gms. SO ₂ per 100 Gms. Solution.	CH ₃ OH.	Solvent.	SO ₂ per 1 Gm. Solvent	
						Grams.	Vols.
0	53.5	115.0	71.1	246.0	Camphor	0.880	308
7	45.0	81.0	59.9	149.4	CH ₃ COOH	0.961	318
12.3	39.9	66.4	52.2	109.2	HCOOH	0.821	351
18.2	32.8	48.8	(17.8°) 44.0	78.6	(CH ₃) ₂ CO	2.07	589
26.0	24.4	32.3	31.7	46.4	SO ₂ Cl ₂	0.323	189

SOLUBILITY OF SULFUR DIOXIDE IN AQUEOUS SOLUTIONS OF ACETIC ACID
AT 27° AND 760mm PRESSURE.
(Oupr, 1926, 1928.)

Percent CH ₃ COOH in solvent	Gms. SO ₂ per 100 gms. solvent	cc SO ₂ per 1cc sat. sol.	Percent CH ₃ COOH in solvent	Gms. SO ₂ per 100 gms. solvent	cc SO ₂ per 1cc sat. sol.
0.0	8.10	26.1	63.51	16.35	61.6
16.72	8.86	31.6	83.59	22.83	84.8
45.58	12.04	44.1	91.89	26.49	97.8
			100	31.5	112.8

SOLUBILITY OF SULFUR DIOXIDE IN CHLOROFORM.

(Lindner, 1912.)

Results at 0°

Pressure in mm. Hg.	Gms. SO ₂ per 100 cc Sat. Sol.
2.7	0.0701
5.6	0.1790
22	0.6982
90.2	3.097
219.6	8.217

Results at 25°.

Pressure in mm. Hg.	Gms. SO ₂ per 100 cc. Sat. Sol.
5.7	0.0669
12.9	0.1712
48	0.6728
200.2	2.954
488.8	7.839

SOLUBILITY OF SULFUR DIOXIDE IN SEVERAL ORGANIC SOLVENTS AT 25°
AND VARYING PRESSURES.

(Horiuti, 1931.)

Results for:

CCl ₄		C ₆ H ₅ Cl		C ₆ H ₆		(CH ₃) ₂ CO		CH ₃ CO ₂ CH ₃	
Pmm	S	Pmm	S	Pmm	S	Pmm	S	Pmm	S
112.4	0.0	11.6	0.0	93.7	0.0	229.2	0.0	213.4	0.0
265.5	1.26	274.9	6.02	294.3	6.18	304.2	14.2	324.4	14.3
357.7	2.08	506.3	11.63	493.7	12.47	381.8	23.7	456.7	25.4
508.6	3.48	669.4	16.66	663.7	17.83	473.4	30.8	602.5	33.6
646.3	4.90	778.3	18.76	808.9	22.52	574.0	36.8	754.4	40.6
814.4	6.73	895.4	22.02	923.2	26.05	740.1	44.5	894.3	45.6
991.8	8.80	1048.5	26.35	1012.2	29.09	994.3	51.9	1038.5	49.7

Pmm = Pressure in millimeters; S = Gm. Mols. SO₂ per 100 gm. mols. sat. solution.

SOLUBILITY OF SULFUR DIOXIDE IN SEVERAL ORGANIC SOLVENTS.

(Horiuti, 1931.)

t°	Solubility of SO ₂ in terms of the Ostwald Solubility Expression l, in:				
	CCl ₄	C ₆ H ₅ Cl	C ₆ H ₆	(CH ₃) ₂ CO	CH ₃ CO ₂ CH ₃
0	—	169.3	—	—	—
10	30.96	97.4	126.4	276.4	254.9
25	18.45	59.14 (20°)	70.01	216.4	182.1
40	12.52	29.92	43.01	171.3	133.8
50	—	22.88	32.63	—	—
60	—	17.83	25.36	—	—
80	—	12.23	—	—	—

SOLUBILITY OF SULFUR DIOXIDE IN SEVERAL SOLVENTS.
(Lloyd, 1918.)

The dry, air free, SO_2 was passed through the solvent until saturation was reached and 5 cc. (usually) of the saturated solution were mixed with a large volume of water and titrated with standardized iodine solution.

t°.	Gms. SO_2 per Liter of Saturated Solution in:				
	Benzene.	Nitro-benzene.	Toluene.	<i>o</i> Nitro-toluene.	Acetic Anhydride.
- 5	...	...	...	...	196
0	...	...	...	...	148 ($d = 1.22$)
+ 5	...	...	...	...	136
10	...	...	...	...	122
15	...	311.4	...	290.8	114
20	...	267.4	217.5	236	106
25	...	227.9	170.4	192.2	99
30	127.5	190	124.4	160.7	90
40	82.9	132	93.6	118.5	...
50	60.3	98.7	77.2	87.2	...
60	34	78.6	54.7	68.8	...

RECIPROCAL SOLUBILITY OF LIQUID SULFUR DIOXIDE AND TOLUENE.
(Zerner, Weisz and Opalski, 1922.)

The accurately weighed mixtures were sealed in tubes of resistance glass and the temperatures determined at which clouding and clearing occurred. The liquid SO_2 contained 0.56 % H_2O and 0.67 % oily residue.

t° of clouding.....	17.0.	21.0.	21.0.	13.5.	7.0.	About -25.0°.
Per cent SO_2 in mixture.	21.64	24.21	34.56	54.50	72.07	92.95.

The correctness of the above results is questioned by Fontein, 1923, who points out that the observed clouding is due to the water content of the SO_2 used. A repetition of the determinations showed Zerner Weisz and Opalski that both toluene and tetralin are completely miscible with sulfur dioxide.

SOLUBILITY OF SULFUR DIOXIDE IN RUBBER. (Venable and Fuwa, 1922.)

100 cc. of rubber saturated with sulfur dioxide at 21° dissolve 1950 cc. SO_2 (0° and 760 mm.). The determination was made by pumping out the gas with a Töpler pump and measuring it over mercury. In the same way 100 cc. of H_2O at 21° was found to dissolve 3,661.7 cc. SO_2 (0° and 760 mm.). The authors also give results for the effect of pressure and temperature upon the solubility of sulfur dioxide in rubber.

Data for the reciprocal Solubility of SO_2 (also of air, CO_2 , NH_3 and HCl) and the vapors of Ether, Methyl Alcohol, Acetone and Chloroform, as determined by measuring at 25° the change in pressure produced by adding a weighed amount of the volatile liquid to a given volume of SO_2 , are given by MacFarlane and Wright, 1934.

Vapor pressure measurements between -20° and +30° are given by Foote and Fleischer, 1934, for the systems composed of SO_2 and each of the following compounds:

* Aniline	Di phenyl amine	Di phenyl ether
* Methyl aniline	* Toluidine	α Naphthol
* Ethyl aniline	Naphthalene	β Naphthol
Di ethyl aniline	Di phenyl	Ethylene glycole

Solid addition compounds were formed with those marked with an *.

Freezing-point data are given for:

SO_2 + SiCl_4 (1)	SO_2 + Cetene (13)
" + SnBr_4 (2)	" + Cetyl alcohol (13)
" + SnCl_4 (2)	" + n Decane (12)
" + SnI_4 (3)	" + Octane (12)(14)
" + TiBr_4 (4)	" + n Dodecane (12)
" + GeCl_4 (4)	" + n Tetra decane (12)
" + CCl_4 (2)(3)	" + n Dotria contane (12)
" + Methyl Alcohol (5)	" + Caprylene (15)
" + Methyl Alcohol +	" + Decalin (cis and trans
Propionic Acid (6)	Deca hydronaphthalene (16)
" + Methyl Ester (6)(7)	" + Styrene (17)
" + Benzene (8)(9)	" + 10-Hendecenoic Acid (17)
" + Cyclohexane (10)(11)	" + 1-Pentane (17)
" + Cyclohexene (11)	" + Vine chloride (17)
" + Cyclohexadiene (11)	" + Camphor (18)
" + n Hexane (12)	" + Toluene (9)
" + n Butane (12)	" + Tetraline, (9)

(1) Bond and Stephens, ; (2) Bond and Beach, 1926; (3) Beach and Bond, 1925; (4) Bond and Crone, 1934; (5) Baume and Pamfil, 1914; (6) Baume et. al., 1914; (7) Baume, 1914; (8) Seyer and Peck, 1930; (9) DeCarli, 1926, 1926a; (10) Seyer and Dunbar, 1922; (11) Seyer and King, 1933; (12) Seyer and Todd, 1931; (13) Seyer and Ball, 1926; (14) Seyer and Gallanger, 1926; (15) Seyer and Hodnett, 1936; (16) Seyer and Cornett, 1937; (17) Marvel and Glavis, 1938; (18) Bellucci and Grassi, 1913.

SULFUR TRIOXIDE SO_3 .

Data for equilibrium in the system $\text{SO}_3 + \text{H}_2\text{O} + \text{H}_2\text{SO}_4$, determined by the freezing-point method, are given by, Moles and Carlota, 1936.

SAMARIUM Sa (or Sm)

SAMARIUM BROMATE $\text{Sa}(\text{BrO}_3)_3 \cdot 9\text{H}_2\text{O}$.

SOLUBILITY OF SAMARIUM BROMATE IN WATER.

(James, Fogg, McIntire, Evans and Donovan, 1927.)

t°	Gms. per 100 gms. sat. sol.		t°	Gms. per 100 gms. sat. sol.	
	$\text{Sa}(\text{BrO}_3)_3 \cdot 9\text{H}_2\text{O}$	$\text{Sa}(\text{BrO}_3)_3$		$\text{Sa}(\text{BrO}_3)_3 \cdot 9\text{H}_2\text{O}$	$\text{Sa}(\text{BrO}_3)_3$
0	33.24	25.50	25	53.97	41.40
5	37.58	28.83	30	57.54	44.14
10	42.02	32.23	35	61.12	46.88
15	46.21	35.45	40	64.67	49.61
20	50.16	38.48	45	68.16	52.28

Solid phase $\text{Sa}(\text{BrO}_3)_3 \cdot 9\text{H}_2\text{O}$ in all cases.

SAMARIUM ACETATE $\text{Sa}(\text{CH}_3\text{COO})_3 \cdot 3\text{H}_2\text{O}$.

100 gms. sat. solution of samarium acetate in water contain 13.05 gm. $\text{Sa}(\text{CH}_3\text{COO})_3$ at 25° . (Meyer and Müller, 1920.)

SAMARIUM LACTATE $\text{Sa}(\text{C}_3\text{H}_5\text{O}_3)_3 \cdot 1\frac{1}{2}\text{H}_2\text{O}$.

1000 cc. sat. solution of samarium lactate in water contain 11.47 gms.
 $\text{Sa}(\text{C}_3\text{H}_5\text{O}_3)_3 \cdot 1\frac{1}{2}\text{H}_2\text{O}$ at 20° .
 (Jantsch, 1926.)

SAMARIUM GLYCOLATE $\text{Sa}(\text{C}_2\text{H}_3\text{O}_3)_2$

100 gms. H_2O dissolve 0.6373 gm. $\text{Sa}(\text{C}_2\text{H}_3\text{O}_3)_2$ at 20° .

(Jantsch and Grünkraut, 1912-13.)

SAMARIUM SULFONATES

SOLUBILITY IN WATER.

Salt.	Formula.	t°.	Gm. Anhydrous Salt per 100 Gms. H_2O .	Authority.
Samarium <i>m</i> Nitrobenzene Sulfonate	$\text{Sa}[\text{C}_6\text{H}_4(\text{NO}_2)\text{SO}_3]_3 \cdot 7\text{H}_2\text{O}$	15	50.9	(Holmberg, 1907.)
Samarium Bromonitrobenzene Sulphonate	$\text{Sa}[\text{C}_6\text{H}_3(\text{Br})(\text{NO}_2)\text{SO}_3]_3 \cdot 10\text{H}_2\text{O}$	25	7.84	(Katz and James, 1913.)

SAMARIUM OXALATE $\text{Sa}_2(\text{C}_2\text{O}_4)_3 \cdot 10\text{H}_2\text{O}$.

One liter H_2O dissolves 0.00054 gm. $\text{Sa}_2(\text{C}_2\text{O}_4)_3$ at 25° , determined by the electrolytic conductivity method.
 (Rimbach and Schubert, 1909.)

SOLUBILITY OF SAMARIUM OXALATE IN AQUEOUS SOLUTIONS OF ACIDS AT 25° .

(Sarver and Brinton, 1927.)

Composition of aq. solvent in normality	Gms. $\text{Sa}_2(\text{C}_2\text{O}_4)_3$ per 100 gms. sat. sol.	Composition of aq. solvent in normality	Gms. $\text{Sa}_2(\text{C}_2\text{O}_4)_3$ per 100 gms. sat. sol.
0.1008 HCl	0.0052	4.00 HCl + sat. $(\text{COOH})_2$	0.0285
0.2576 "	0.0181	6.00 " + " "	0.1165
0.5702 "	0.0267	0.2482 HNO_3	0.0189
0.978 "	0.0712	1.992 "	0.3408
1.484 "	0.1452	4.054 "	1.062
2.000 "	0.2296	2.00 " + 0.1 (COOH)	0.0905
0.978 " + 0.1 $(\text{COOH})_2$	0.0061	3.03 " + 0.1 "	0.2898
2.000 " + 0.1 "	0.0421	4.00 " + 0.1 "	0.6327
2.865 " + 0.1 "	0.1228	2.00 " + 0.5 "	0.0134
3.965 " + 0.1 "	0.3202	3.03 " + 0.5 "	0.0504
0.978 " + 0.5 "	0.0010	4.00 " 0.5 "	0.1603
2.000 " + 0.5 "	0.0061	0.086 H_2SO_4	0.0090
2.865 " + 0.5 "	0.0175	0.419 "	0.424
3.965 " + 0.5 "	0.0594	0.958 "	0.1042
1.484 " + sat. "	0.0031	1.846 "	0.2189

SOLUBILITY OF SAMARIUM OXALATE IN AQUEOUS SOLUTIONS OF NITRIC AND OXALIC ACIDS AT 90° .

(Neckers and Kremers, 1928.)

Composition of aq. solvent in normality	Gms. Sa_2O_3 per 100 cc sat. sol.	Composition of aq. solvent in normality	Gms. Sa_2O_3 per 100 cc sat. sol.
2.5 HNO_3	1.878	2.5 + 5% $(\text{COOH})_2$	0.5457
5.0 "	5.675	5.0 + " "	4.1520

SOLUBILITY OF SAMARIUM OXALATE IN AQUEOUS SOLUTIONS OF SULFURIC ACID

AT 25°.

(Wirth, 1912.)

Normality of Aq. H ₂ SO ₄ .	Gm. Sa ₂ (C ₂ O ₄) ₃ per 100 Gms. Sat. Sol.	Solid Phase.	Normality of Aq. H ₂ SO ₄ .	Gm. Sa ₂ (C ₂ O ₄) ₃ per 100 Gms. Sat. Sol.	Solid Phase.
I	0.1015	Sa ₂ (C ₂ O ₄) ₃ ·10H ₂ O	2.8	0.3886	Sa ₂ (C ₂ O ₄) ₃ ·10H ₂ O
I.445	0.1804	"	4.32	0.7008	"
I.93	0.2254	"	6.175	1.072	"

SAMARIUM CHLORIDE SaCl₃·6H₂O.

SOLUBILITY IN WATER AND IN AQUEOUS HYDROCHLORIC ACID.

(Williams, Fogg and James, 1925.)

Cl

Saturation was secured by constant rotation for 9 hours or more and approaching equilibrium from above and from below. Approximately 1.0 cc. quantities of the saturated solutions were diluted to about 150 cc. and precipitated with oxalic acid. The precipitate was filtered and the residue ignited and weighed.

Results for Water.

t°.	Gms. SaCl ₃ per 100 gms. sat. sol.	Solid Phase.
10.....	48.02	SaCl ₃ ·6H ₂ O
20.....	48.29	"
30.....	48.60	"
40.....	49.20	"
50.....	49.98	"

Results for Aq. HCl of $d = 1.1051$.

t°.	Gms. SaCl ₃ per 100 gms. sat. sol.	Solid Phase.
10.....	21.84	SaCl ₃ ·6H ₂ O
20.....	22.42	"
30.....	23.97	"
40.....	25.52	"
50.....	27.49	"

100 gms. Pyridine dissolve 6.38 gms. SaCl at 15°. (Matignon, 1906, 1909.)

SAMARIUM CHROMATE Sa(CrO₄)₃·8H₂O.

100 gms. sat. solution of Samarium Chromate in Water contain 0.043 gm. Sa(CrO₄)₃ at 25°. (Britton, 1924.)

SAMARIUM NITRATE Sa(NO₃)₃·6H₂O.

SOLUBILITY OF SAMARIUM NITRATE IN AQUEOUS SOLUTIONS OF NITRIC ACID.

(Quill and Robey, 1937.)

NO

Results at 25°

Gms. per 100 gms. sat. sol.	Solid Phase	d. of sat. sol.
Sa(NO ₃) ₃	HNO ₃	
58.95	0.0 (1)	Sa(NO ₃) ₃ ·6H ₂ O
52.08	6.15	"
46.52	11.34	"
16.40	44.38	"
14.20	48.40	"
13.64	51.58	"

Results at 50°

Gms. per 100	gms. sat. sol.	Solid Phase
$\text{Sa}(\text{NO}_3)_3$	HNO_3	
64.81	0.0	$\text{Sa}(\text{NO}_3)_3 \cdot 6\text{H}_2\text{O}$
62.97	2.12	"
57.57	7.53	"
45.05	22.38	"
33.20	36.40	"
30.22	47.52	" + $\text{Sa}(\text{NO}_3)_3 \cdot 4\text{H}_2\text{O}$
27.89	46.21	$\text{Sa}(\text{NO}_3)_3 \cdot 4\text{H}_2\text{O} (?)$

(1) density of sat. solution = 1.782

SAMARIUM Double NITRATES.

SOLUBILITY IN CONC. HNO₃ OF $d_{15} = 1.325$ AT 16°.

(Jantsch, 1912.)

Salt.	Formula.	Gms. Hydrated Salt per 100 cc. Sat. Sol.
Samarium Magnesium Nitrate	[Sa(NO ₃) ₆]Mg ₃ ·24 H ₂ O	24.55
" Nickel	" Ni ₃	29.11
" Cobalt	" Co ₃	34.27
" Zinc	" Zn ₃	36.47
" Manganese	" Mn ₃	50.04

Sa SAMARIUM

1468

SAMARIUM Dimethyl PHOSPHATE $\text{Sa}_2[(\text{CH}_3)_2\text{PO}_4]_6$.

100 gms. H_2O dissolve 35.2 gms. $\text{Sa}_2[(\text{CH}_3)_2\text{PO}_4]_6$ at 25° and about 10.8 gms. at 95° . (Morgan and James, 1914.)

SAMARIUM SULFATE $\text{Sa}_2(\text{SO}_4)_3 \cdot 8\text{H}_2\text{O}$.

100 gms. H_2O dissolve 2.67 gms. $\text{Sa}_2(\text{SO}_4)_3 \cdot 8\text{H}_2\text{O}$ at 20° and 1.99 gms. at 40° . (Jackson and Reinacker, 1930.)

SOLUBILITY IN AQUEOUS SOLUTIONS OF AMMONIUM SULFATE AT 25° .*

(Keyes and James, 1914.)

Gms. per 100 Gms. H_2O .		Solid Phase.	Gms. per 100 Gms. H_2O .		Solid Phase.
$(\text{NH}_4)_2\text{SO}_4$.	$\text{Sa}_2(\text{SO}_4)_3$.		$(\text{NH}_4)_2\text{SO}_4$.	$\text{Sa}_2(\text{SO}_4)_3$.	
0.03	2.1	$\text{Sa}_2(\text{SO}_4)_3$	32.5	0.9	1.1.7
0.8	2	"	46.3	1	"
1.1	2.8	" + 1.1.7	77.5	1.3	" + $(\text{NH}_4)_2\text{SO}_4$
1.9	1.5	1.1.7	77.3	0.3	$(\text{NH}_4)_2\text{SO}_4$
7.4	0.8	"	76.8	0.6	"
18.8	0.8	"			

1.1.7 = $\text{Sa}_2(\text{SO}_4)_3 \cdot (\text{NH}_4)_2\text{SO}_4 \cdot 7\text{H}_2\text{O}$.

SOLUBILITY IN AQUEOUS SOLUTIONS OF SODIUM SULFATE AT 25° .*

(Keyes and James, 1914.)

Gms. per 100 Gms. H_2O .		Solid Phase.	Gms. per 100 Gms. H_2O .		Solid Phase.
Na_2SO_4 .	$\text{Sa}_2(\text{SO}_4)_3$.		Na_2SO_4 .	$\text{Sa}_2(\text{SO}_4)_3$.	
...	2.05	$\text{Sa}_2(\text{SO}_4)_3$	10.51	0.012	$2\text{Sa}_2(\text{SO}_4)_3 \cdot 3\text{Na}_2\text{SO}_4 \cdot 6\text{H}_2\text{O}$
0.1	2	"	14.71	0.010	"
0.5	0.11	$2\text{Sa}_2(\text{SO}_4)_3 \cdot 3\text{Na}_2\text{SO}_4 \cdot 6\text{H}_2\text{O}$	20.02	0.012	"
1.9	0.03	"	23.68	0.018	"
6.44	0.016	"	27.40	0.011	"

* The mixtures were rotated at constant temperature for 5 months.

100 cc. anhydrous hydrazine dissolve 1 gm. $\text{Sa}_2(\text{SO}_4)_3$ at room temp. (Welsh and Broderson, 1915.)

STIBIUM (Antimony) Sb

Fusion-point data are given for:

Sb + I (Jaeger and Dornbosch, 1912.) Sb + Zn + Pb (Tammann and Schachtmeister, 1924.)
 " + " + As (Quercigh, 1912.)
 " + S (Jaeger and Dornbosch, 1912.) " + " + Bi " " "
 " + Al + Pb " " "

ANTIMONY TriBROMIDE SbBr_3 .

SOLUBILITY IN BENZENE DETERMINED BY "SYNTHETIC METHOD."

(Menschutkin, 1910.)

t°.	Gms. SbBr_3 per 100 Gms. Sat. Sol.	Solid Phase.	t°.	Gms. SbBr_3 per 100 Gms. Sat. Sol.	Solid Phase.
5.6 m. pt.	0	C_6H_6	90	83	$2\text{SbBr}_3 \cdot \text{C}_6\text{H}_6$
4.5 Eutec.	8.3	$\text{C}_6\text{H}_6 + 2\text{SbBr}_3 \cdot \text{C}_6\text{H}_6$	92.5 m. pt.	90.2	"
15	12.5	$2\text{SbBr}_3 \cdot \text{C}_6\text{H}_6$	91.5	92.8	"
35	23	"	90	93.8	"
55	39	"	85 Eutec.	96.3	$2\text{SbBr}_3 \cdot \text{C}_6\text{H}_6 + \text{SbBr}_3$
75	60.5	"	90	98	SbBr_3
85	74.3	"	94	100	"

ANTIMONY TriBROMIDE

RECIPROCAL SOLUBILITIES OF ANTIMONY TRIBROMIDE AND VARIOUS ORGANIC COMPOUNDS, DETERMINED BY THE "SYNTHETIC METHOD."

(Menschutkin, 1911.)

SbBr ₃ + Acetic Acid.		SbBr ₃ + Benzoic Acid.		SbBr ₃ + Benzoyl Chloride.		SbBr ₃ + Benzene Sulphonic Acid.	
t°.	Gms. SbBr ₃ per 100 Gms. Sat. Sol.	t°.	Gms. SbBr ₃ per 100 Gms. Sat. Sol.	t°.	Gms. SbBr ₃ per 100 Gms. Sat. Sol.	t°.	Gms. SbBr ₃ per 100 Gm. Sat. Sol.
16.5 *	0	120 *	0	— 0.5 *	0	52.5 *	0
15	12.2	115	20.1	— 3	19.5	50	15.8
10	41.8	110	36.8	— 6 †	32	47.5	26.2
4 †	58.2	105	50	+10	41.2	44 †	36.9
20	64.3	100	61.5	20	47.5	50	39.1
40	72.5	95	71	30	54	60	45.7
60	81.9	85	83.1	40	60.8	70	55.2
70	97.1	79 †	87.6	50	67.8	80	68.1
80	92.4	85	92	60	74.9	85	77.6
90	97.8	90	96.4	80	89.4	90	90.3
94	100	94	100	94	100	94	100

Molecular compounds are not formed in the above systems. The diagram in each case consists of two arms meeting at the eutectic.

SbBr₃ + Acetophenone.

t°.	Gms. SbBr ₃ per 100 Gms. Sat. Sol.	Solid Phase.
19.5 *	0	C ₆ H ₅ COCH ₃
15	22.7	"
1.5 *	48.6	" + 1.1
20	56.8	"
30	63.3	"
37.5 *	75	"
31 †	83.2	1.1 + SbBr ₃
40	84.6	SbBr ₃
60	88.4	"
80	94.1	"
94	100	"

SbBr₃ + Amylbenzene.

t°.	Gms. SbBr ₃ per 100 Gms. Sat. Sol.	Solid Phase.
—70	4.5	SbBr ₃ ·C ₆ H ₅ ·C ₅ H ₁₁
—50	8.3	"
—30	16.6	"
—25	21	"
—17 †	32.5	" + SbBr ₃
—10	33.5	SbBr ₃
0	35.6	"
20	41.6	"
40	51.3	"
60	65	"
80	84	"

SbBr₃ + Anisole.

t°.	Gms. SbBr ₃ per 100 Gms. Sat. Sol.	Solid Phase.
—34 *	0	C ₆ H ₅ OCH ₃
—35	2.5	" + 1.1
—20	11.7	1.1
0	26.5	"
10	37.1	"
20	50.5	"
25	59	"
30.5 *	77	"
30 †	77.9	" + SbBr ₃
40	80.6	SbBr ₃
60	86.4	"
80	93.6	"

Br

SbBr₃ + Benzaldehyde.

t°.	Gms. SbBr ₃ per 100 Gms. Sat. Sol.	Solid Phase.
—20	38.4	1.1
0	45.5	"
20	54.3	"
35	64.1	"
40	70.3	"
41.5 *	77.2	"
37.8 †	84.4	1.1 + SbBr ₃
55	88	SbBr ₃
75	93.1	"
85	96.1	"
90	98.2	"
94	100	"

SbBr₃ + Benzonitrile.

t°.	Gms. SbBr ₃ per 100 Gms. Sat. Sol.	Solid Phase.
—13.2 *	0.0	C ₆ H ₅ CN
—16	19.2	"
—18 †	28.7	" + 1.1
0	43	1.1
20	59	"
30	67	"
38 *	77.8	"
35 †	82.5	1.1 + SbBr ₃
55	87.5	SbBr ₃
75	93.3	"
85	96.5	"
90	98.3	"
94	100	"

SbBr₃ + Benzophenone.

t°.	Gms. SbBr ₃ per 100 Gms. Sat. Sol.	Solid Phase.
48 *	0	C ₆ H ₅ CO·C ₆ H ₅
40	24	"
29 †	41.2	" + 1.1
40	50	1.1
45	56.3	"
48.5 *	66.4	"
45	76	"
40	80	1.1 + SbBr ₃
50	82.6	SbBr ₃
70	88.7	"
80	92.4	"
90	97.3	"
94	100	"

* m. pt.

† Eutec.

‡ tr. pt.

1.1 = compound of equimolecular amounts of the two constituents in each case.

RECIPROCAL SOLUBILITIES OF ANTIMONY TRIBROMIDE AND VARIOUS ORGANIC COMPOUNDS, DETERMINED BY THE "SYNTHETIC METHOD."
(Menschutkin, 1910.)

SbBr ₃ + Brombenzene.		SbBr ₃ + Chlorbenzene.		SbBr ₃ + Iodobenzene.		SbBr ₃ + Fluorbenzene.	
t°.	Gms. SbBr ₃ per 100 Gms. Sat. Sol.	t°.	Gms. SbBr ₃ per 100 Gms. Sat. Sol.	t°.	Gms. SbBr ₃ per 100 Gms. Sat. Sol.	t°.	Gms. SbBr ₃ per 100 Gms. Sat. Sol.
-31 *	0	-45.2 *	0	-28.6 *	0	-39.2 *	0
-32	5.7	-47 †	5.2	-30.3	7.0	-39.5 †	1.3
-25 †	9.5	-40	6.8	-32 †	14.3	-25	4.3
-15	15	-30	9.6	-20	21.6	-15	6.7
-5	20.8	-20	12.6	-10	27.5	+5	12.6
+5	26.8	-10	16	0	33.4	25	21.8
15	33	0	20	+10	39.3	45	35.3
25	39.6	20	30	20	45.2	55	45.5
45	54.6	40	45.4	40	57.6	65	60.8
65	71.9	60	65.8	60	71.1	75	81.8
85	90.7	80	86.3	80	86.3	85	93.5
94	100	94	100	94	100	94	100

SbBr ₃ + p Dibrombenzene.		SbBr ₃ + Dichlorbenzene.		SbBr ₃ + Nitrobenzene.		SbBr ₃ + m Dinitrobenzene.	
t°.	Gms. SbBr ₃ per 100 Gms. Sat. Sol.	t°.	Gms. SbBr ₃ per 100 Gms. Sat. Sol.	t°.	Gms. SbBr ₃ per 100 Gms. Sat. Sol.	t°.	Gms. SbBr ₃ per 100 Gms. Sat. Sol.
88 *	0	54.5 *	0	6 *	0	90 *	0
85	10	51.5	14	1	22	80	29.1
80	25.2	48.5 †	26.5	-4	37.4	70	50
75	39.2	55	35.9	-9	48.4	60	63
70	52	60	43.1	-14.5 †	55.3	50	70.8
65 †	62.2	65	50.7	-5	58.3	47.5 †	72
70	68.7	70	58.8	+5	61.5	50	73.4
75	75.3	75	67.2	25	68.6	60	78.2
80	81.8	80	75.8	45	76.6	70	84
85	88.3	85	84.5	65	85.3	80	90.4
90	94.3	90	93.4	85	94.7	90	96.8
94	100	94	100	94	100	94	100

Molecular compounds are not formed in the above systems. The diagram in each case consists of two arms meeting at the eutectic.

SbBr ₃ + Ethylbenzene.			SbBr ₃ + Propylbenzene.			SbBr ₃ + p Cymene.		
t°.	Gms. SbBr ₃ per 100 Gms. Sat. Sol.	Solid Phase.	t°.	Gms. SbBr ₃ per 100 Gms. Sat. Sol.	Solid Phase.	t°.	Gms. SbBr ₃ per 100 Gms. Sat. Sol.	Solid Phase.
-93 *	0	C ₆ H ₅ .C ₂ H ₅	-80	1.3	1.1	-75 *	0	
-93.2 †	0.4	" + 1.1	-60	3.7	"	-77 †	2	
-70	1	1.1	-40	9.4	"	-50	6.1	1.1
-50	2.2	"	-20	22.5	"	-30	12.3	"
-30	4.8	"	-10	38.4	"	-10	27	"
-10	12	"	-5 †	49	1.1 + SbBr ₃	0	42.3	"
+10	29.2	"	+10	53.3	SbBr ₃	+5 †	51.5	1.1 + SbBr ₃
20	46.3	"	20	57.1	"	20	56	SbBr ₃
29 †	69.7	1.1 + SbBr ₃	40	66.2	"	40	64.1	"
50	78.2	SbBr ₃	60	77.2	"	60	75	"
70	87.3	"	80	89.8	"	80	88.5	"
90	97.7	"	94	100	"	94	100	"

* m. pt.

† Eutec.

‡ tr. pt.

1.1 = compound of equimolecular amounts of the two constituents in each case.

RECIPROCAL SOLUBILITIES OF ANTIMONY TRIBROMIDE AND VARIOUS ORGANIC COMPOUNDS, DETERMINED BY THE "SYNTHETIC METHOD."

(Menschutkin, 1911.)

SbBr ₃ + Cyclohexane.			SbBr ₃ + Pseudo Cymene.			SbBr ₃ + Mesitylene.		
t°.	Gms. SbBr ₃ per 100 Gms. Sat. Sol.	Solid Phase.	t°.	Gms. SbBr ₃ per 100 Gms. Sat. Sol.	Solid Phase.	t°.	Gms. SbBr ₃ per 100 Gms. Sat. Sol.	Solid Phase.
6.4 *	0	C ₆ H ₁₂	-57.2 *	0	C ₆ H ₃ (CH ₃) ₂ 1, 2, 4	-54.4 *	0	C ₆ H ₃ (CH ₃) ₂ 1, 3, 5
6 †	0.3	C ₆ H ₁₂ +SbBr ₃	-58.8 †	9.7	" +1.1	-55.2 †	2.1	" +1.1
20	1.4	SbBr ₃	-50	11	1.1	-30	3.6	1.1
40	3.7	"	-30	16.2	"	-10	9	"
60	7.1	"	-10	31	"	+10	25.4	"
80	12.5	"	0	47.6	"	20	35.5	"
liquid layers formed			7 §	63.5	1.1+2.1	29 ‡	46.5	1.1+2.1
92.5	17.4	97.6	15	67.4	2.1	40	54.2	2.1
110	25.8	96.5	25	73	"	50	61.7	"
130	36.4	95	33 §	79.1	2.1+SbBr ₃	60	70.2	"
150	47.8	92.7	50	82.8	SbBr ₃	69.5 *	85.8	"
170	62.3	86.3	70	88.4	"	69 ‡	87.7	2.1+SbBr ₃
175 ‡	74.0		90	97.4	"	80	92.7	SbBr ₃

 SbBr₃ + Diphenylmethane. SbBr₃ + Naphthalene. SbBr₃ + α Nitronaphthalene.

t°.	Gms. SbBr ₃ per 100 Gms. Sat. Sol.	Solid Phase.	t°.	Gms. SbBr ₃ per 100 Gms. Sat. Sol.	Solid Phase.	t°.	Gms. SbBr ₃ per 100 Gms. Sat. Sol.	Solid Phase.
26 *	0	CH ₂ (C ₆ H ₅) ₂	79.4 *	0	C ₁₀ H ₈	57 *	0.0	α C ₁₀ H ₇ NO ₂
22.5 †	12.8	" +2.1	75	23.7	"	50	23.2	"
40	22.8	2.1	70	37.4	"	40	42.6	"
50	29.5	"	65	48.6	"	33.5 †	50.5	" +1.1
60	37.5	"	57	61.2	" +2.1	37.5	62.6	1.1 †
70	47.8	"	60	68	2.1	38.2 *	67.6	"
80	60.2	"	65	81.3	"	38 †	68	1.1+SbBr ₃
90 *	81.1	"	66 *	84.9	"	50	73.4	SbBr ₃
85	89.6	"	65 †	86.7	2.1+SbBr ₃	70	83.8	"
82 †	92.2	2.1+SbBr ₃	75	90.1	SbBr ₃	90	96.4	"
90	96.2	SbBr ₃	85	94.9	"			
94	100	"	90	97.7	"			

Br

SbBr ₃ + Diphenyl.			SbBr ₃ + Phenol.			SbBr ₃ + Phenetol.		
t°.	Gms. SbBr ₃ per 100 Gms. Sat. Sol.	Solid Phase.	t°.	Gms. SbBr ₃ per 100 Gms. Sat. Sol.	Solid Phase.	t°.	Gms. SbBr ₃ per 100 Gms. Sat. Sol.	Solid Phase.
70.5 *	0	C ₆ H ₅ C ₆ H ₅	41 *	0	C ₆ H ₅ OH	-28.6 *	0	C ₆ H ₅ OC ₂ H ₅
60	35.7	"	35	22.5	"	-29 †	1.6	" +1.1
50	54.3	"	30	40	"	-10	4.8	1.1
47 †	57.4	" +2.1	28.5 †	44.6	" +2.1	+10	12.9	"
55	68.5	2.1	40	53	2.1	20	19.2	"
60.5 *	82.7	"	50	62.5	"	30	29.7	"
70	86.5	SbBr ₃	60	75.8	"	40	40.2	"
80	91.5	"	65	84.7	"	48.8 *	74.7	"
90	97.3	"	66.5 *	88.5	"	47 †	77.8	1.1+SbBr ₃
94	100	"	75	91.7	SbBr ₃	60	83	SbBr ₃
			85	95.8	"	70	87.3	"
			90	98.1	"	90	97.4	"

* m. pt.

† Eutec.

‡ crit. t.

§ tr. pt.

¶ Not obtained regularly, in such cases, single eutectic at 23° and 61.5 per cent SbBr₃.

1.1 = compound of equimolecular amounts of the two constituents in each case.
 2.1 = compound of 2 molecules of SbBr₃ with one molecule of the other constituent.

RECIPROCAL SOLUBILITIES OF ANTIMONY TRIBROMIDE IN VARIOUS ORGANIC COMPOUNDS, DETERMINED BY THE "SYNTHETIC METHOD."

(Menschutkin, 1910-12.)

SbBr ₃ + α Brom-naphthalene.		SbBr ₃ + α Chlor-naphthalene.		SbBr ₃ + β Chlor-naphthalene.		SbBr ₃ + Tetrahydrobenzene.	
t°.	Gms. SbBr ₃ per 100 Gms. Sat. Sol.	t°.	Gms. SbBr ₃ per 100 Gms. Sat. Sol.	t°.	Gms. SbBr ₃ per 100 Gms. Sat. Sol.	t°.	Gms. SbBr ₃ per 100 Gms. Sat. Sol.
3 *	0	-17 *	0	56 *	0	...	...
0	15.8	-21	13.8	50	26.1	-5	11.7
-3.5 †	31.4	-24.5 †	22.6	45	38.5	15	15.1
15	38.7	-10	27.3	40	49	35	24.1
35	49.9	+10	35.5	37.5 †	53.6	55	41
45	56.9	30	46.7	45	58.8	65	55.1
55	64.7	50	61.6	55	66.8	70	64.5
65	72.9	60	69.9	65	75.2	75	76.2
75	81.8	70	78.6	75	83.8	80	84.4
80	86.3	80	87.5	80	88.1	85	90.7
85	90.8	90	96.6	85	92.4	90	95.8
90	95.4	94	100	90	96.7	94	100

SbBr ₃ + o Chlortoluene.		SbBr ₃ + m Chlortoluene.		SbBr ₃ + p Chlortoluene.		SbBr ₃ + m Nitrotoluene.	
t°.	Gms. SbBr ₃ per 100 Gms. Sat. Sol.	t°.	Gms. SbBr ₃ per 100 Gms. Sat. Sol.	t°.	Gms. SbBr ₃ per 100 Gms. Sat. Sol.	t°.	Gms. SbBr ₃ per 100 Gms. Sat. Sol.
-36.2 *	0	-47.8 *	0	6.2 *	0	16 *	0
-38.5 †	10.7	-50 †	8.1	2.5 †	23.3	10	24.2
-20	15.4	-30	11.7	20	33	5	39
0	22.5	-10	17.5	30	39.3	0	46.6
+20	32.5	+10	25.8	40	47.2	-9 †	56.8
30	38.8	30	37.5	50	56.3	+10	62.7
40	46.8	40	45.1	60	66.7	30	69.7
50	56	50	54.4	70	77.8	50	77.5
60	66.5	60	65	80	88.2	60	81.5
70	77.8	70	77	90	97	70	86.3
80	88.2	80	88.2	94	100	80	91.4
90	97	90	97			90	97.2

Molecular compounds are not formed in the above systems. The diagram in each case consists of two arms meeting at the eutectic.

SbBr ₃ + Toluene.			SbBr ₃ + o Nitrotoluene.			SbBr ₃ + p Nitrotoluene.		
t°.	Gms. SbBr ₃ per 100 Gms. Sat. Sol.	Solid Phase.	t°.	Gms. SbBr ₃ per 100 Gms. Sat. Sol.	Solid Phase.	t°.	Gms. SbBr ₃ per 100 Gms. Sat. Sol.	Solid Phase.
-93 *	0	C ₆ H ₅ .CH ₃	-8.5 *	0	o NO ₂ .C ₆ H ₄ .CH ₃	52.5 *	0	p NO ₂ .C ₆ H ₄ .CH ₃
-93.5 †	1.0	+1.1	-13.5	19.5	+1.1	45	29.8	"
-80	2.4	1.1	0	27.6	1.1	40	42.2	"
-60	6.2	"	10	35.6	"	35	50	"
-40	12.4	"	20	47.5	"	25	61	"
-20	25.7	"	25	55.7	"	16 †	67	+SbBr ₃
-1 †	53.1	1.1+2.1	31 †	70	+SbBr ₃	30	71.6	SbBr ₃
+20	69.4	2.1	40	73.5	SbBr ₃	50	78.9	"
30 †	78	2.1+SbBr ₃	50	77.5	"	60	82.9	"
40	80.6	SbBr ₃	60	81.7	"	70	87.2	"
60	86.6	"	80	91.4	"	80	92	"
80	93.8	"	90	97.2	"	90	97.5	"
94	100	"						

* m. pt.

† Eutec.

‡ tr. pt.

1.1 = compound of equimolecular amounts of the two constituents in each case.
 2.1 = compound of 2 molecules of SbBr₃ with 1 molecule of the other constituent.

RECIPROCAL SOLUBILITIES OF ANTIMONY TRIBROMIDE AND VARIOUS ORGANIC COMPOUNDS, DETERMINED BY THE "SYNTHETIC METHOD."
(Menschutkin, 1910-11.)

SbBr ₃ + Tri-phenylmethane.		SbBr ₃ + <i>o</i> Xylene.		SbBr ₃ + <i>m</i> Xylene.		SbBr ₃ + <i>p</i> Xylene.	
t°.	Gms. SbBr ₃ per 100 Gms. Sat. Sol.	t°.	Gms. SbBr ₃ per 100 Gms. Sat. Sol.	t°.	Gms. SbBr ₃ per 100 Gms. Sat. Sol.	t°.	Gms. SbBr ₃ per 100 Gms. Sat. Sol.
92 *	0	-29 *	0	-57 *	0	14 *	0
85	18	-33 †	10.5	-59.2 †	5.5	12	16.6
80	30.1	-20	17	-45	10	10 †	28
70	47	-10	24.6	-35	14.2	20	36
60	58.2	0	34.5	-25	20	30	44.6
48 †	67.1	20	65.8	-5	38.8	40	53.8
60	73.3	24 *	77.2	+ 5	56.6	50	63.5
70	79.5	22.5 †	78.6	12.5 †	75.4	60	74
80	86.4	30	80	25	77.6	67.5 *	87.3
90	95.2	50	84.7	45	82.3	66.5 †	88.3
94	100	70	90.1	65	87.9	75	91.4
		90	97.7	87	95.3	85	95.7

* m. pt.

† Eutec.

† tr. pt.

In the case of each of the above xylenes the compound existing between the first and second eutectic consists of equimolecular amounts of SbBr₃ and xylene.

Br

Freezing-point data are given for:

SbBr ₃ + SbCl ₃ (Bernadis, 1912.)	SbBr ₃ + Benzanilide (Vanstone, 1925.)
" + SnBr ₄ (Pusin and Makuc, 1938.)	" + Brythrite (Rusin and Dezelic, 1932.)
" + Br " " "	" + Aniline (Kurakov, 1932.)
" + AsBr ₃ (Pusin and Lowy, 1926.)	(Kurakov, Krotkov and Oksman, 1915.)
" + Azobenzene (Vanstone, 1914.)	" + Benzophenone " " "
" + Ribenzyl " " "	" + Toluene " " "
" + Stilbene " " "	" + Triphenylmethane " " "

ANTIMONY Nitroso β Phenyl HYDROXYLAMINE(Cupferronate) Sb[C₆H₅.N(NO).O]₃

One liter sat. solution of the salt in water contain 0.000045 gm. atom (= 0.0055 gm.) Sb[C₆H₅.N(NO).O]₃ at 18°. (Pinkus and Martin, 1927.)

ANTIMONY TriPHENYL Sb(C₆H₅)₃.

Freezing-point data are given for mixtures of antimony triphenyl and mercury diphenyl and for antimony triphenyl and tin tetraphenyl. (Cambì, 1912.)

ANTIMONY TRICHLORIDE SbCl_3 .**SOLUBILITY IN WATER. SOLID PHASE SbCl_3 .**

(Meerburg — Z. anorg. Chem. 33, 299, 1903.)

t°.	Mols. SbCl_3 per 100 Mols. H_2O .	Gms. SbCl_3 per 100 g. H_2O .	t°.	Mols. SbCl_3 per 100 Mols. H_2O .	Gms. SbCl_3 per 100 g. H_2O .
0	47.9	601.6	35	91.6	1152.0
15	64.9	815.8	40	108.8	1368.0
20	{ 72.4	910.1	50	152.5	1917.0
	{ 74.1	931.5	60	360.4	4531.0
25	78.6	988.1	72	∞	∞
30	84.9	1068.0			

100 gms. sat. sol. of SbCl_3 in H_2O contain 90.90 gms. SbCl_3 at 25° } (Miyake,
 » » 10.55 % HCl » 90.07 » } 1924, 1925.)

Data for the system $\text{SbCl}_3 + \text{KCl} + \text{H}_2\text{O}$ are given. The double salts
 2 KClSbCl_3 and 7 $\text{KCl} \cdot 3 \text{SbCl}_3$ were found but no mixed crystals as mentioned
 by Jordis, 1903.

Cl

**SOLUBILITY OF ANTIMONY TRICHLORIDE IN AQUEOUS HYDROCHLORIC
ACID. SOLID PHASE SbCl_3 . TEMP. 20°.**

(Meerburg.)

Mols. per 100 Mols. H_2O .		Gms. per 100 g. H_2O .		Mols. per 100 Mols. H_2O .		Gms. per 100 g. H_2O .	
HCl.	SbCl_3 .	HCl.	SbCl_3 .	HCl.	SbCl_3 .	HCl.	SbCl_3 .
0	72.4	0.0	910.1	9.1	68.9	18.41	866.4
2.4	71.2	4.86	895.4	11.7	68.1	23.68	856.3
6.1	69.9	12.34	879.0	28.7	62.8	58.08	789.8
8.3	68.2	16.80	857.6				

100 gms. absolute acetone dissolve 537.6 gms. SbCl_3 at 18°. d_{20}^4 sat. sol. = 2.216.
 (Naumann, 1904.)

100 gms. ethyl acetate dissolve 5.9 gms. SbCl_3 at 18° d sat. sol. = 1.7968.
 (Naumann, 1910.)

100 gms. acetylene tetrachloride ($\text{C}_2\text{H}_2\text{Cl}_4$) dissolve 21.75 gms. SbCl_3 at 25°.

(de Pauw, 1922, 1926.)

100 gms. of a sat. solution of antimony pentachloride (SbCl_5) in Selenium
 oxychloride (SeOCl_2) contain 38.64 gms. SbCl_3 at 25°.

(Wise, 1923.)

RECIPROCAL SOLUBILITIES OF ANTIMONY TRICHLORIDE AND VARIOUS ORGANIC COMPOUNDS, DETERMINED BY THE "SYNTHETIC METHOD."

(Menschutkin, 1911.)

SbCl ₃ + Acetic Acid.			SbCl ₃ + Acetophenone.			SbCl ₃ + Anisol.		
t°.	Gms. SbCl ₃ per 100 Gms. Sat. Sol.	Solid Phase.	t°.	Gms. SbCl ₃ per 100 Gms. Sat. Sol.	Solid Phase.	t°.	Gms. SbCl ₃ per 100 Gms. Sat. Sol.	Solid Phase.
16.5 *	0	CH ₃ COOH	19.5 *	0	C ₆ H ₅ COCH ₃	-34 *	0	C ₆ H ₅ OCH ₃
10	22.7	"	15	14.3	"	-36.5 †	11.8	" +1.1
0	42.5	"	5	28.5	"	-30	16	1.1
-5	48.5	"	1 †	31.8	" +1.1	-10	28.3	"
-9 †	52.7	" +1.1	15	35.4	1.1	+10	43	"
0	59	1.1	35	41.6	"	20	52.8	"
10	67.3	"	55	55.2	"	25 †	63.6	" +2.1
19 *	79.1	"	60.5 *	65.4	"	35	70	2.1
25	81.5	SbCl ₃	45	79.3	"	41.5 *	80.9	"
45	87.4	"	32 †	84	1.1 + SbCl ₃	40 †	84.5	" + SbCl ₃
65	95.3	"	50	89.3	SbCl ₃	60	92	SbCl ₃
73	100	"	70	98.2	"	70	98	"

SbCl ₃ + Aniline.			SbCl ₃ + Benzaldehyde.			SbCl ₃ + Benzophenone.		
t°.	Gms. SbCl ₃ per 100 Gms. Sat. Sol.	Solid Phase.	t°.	Gms. SbCl ₃ per 100 Gms. Sat. Sol.	Solid Phase.	t°.	Gms. SbCl ₃ per 100 Gms. Sat. Sol.	Solid Phase.
-7.2 †	1	C ₆ H ₅ NH ₂ + 1.4	10	43.5	1.1	48 *	0	C ₆ H ₅ COC ₆ H ₅
+20	7	1.4	20	47.5	"	40	16.3	"
60	18.7	"	30	52.4	"	35 †	21.6	" +1.1
77 †	29.6	1.4 + 1.3	40	60.2	"	45	26.2	1.1
88 *	44.8	1.3	43.5 *	68.1	"	55	31.4	"
87 †	46.3	1.3 + 1.2	40	74.2	"	65	37.5	"
94.5 *	54.9	1.2	30	80.6	"	76 *	55.4	"
89.5 †	61.7	1.2 + 1.1	25 †	83	1.1 + SbCl ₃	65	71.6	"
100.5 *	71	1.1	35	85	SbCl ₃	45	80.6	"
70	82.2	"	45	87.5	"	30 †	82.7	" + SbCl ₃
31 †	88	1.1 + SbCl ₃	65	95.2	"	50	87	SbCl ₃
60	94.9	SbCl ₃	73	100	"	70	97.7	"

Cl

1.1 = compound of equimolecular amounts of the two constituents in each case.
2.1 = compound of 2 molecules of SbCl₃ with 1 molecule of the other constituent.

1.2, 1.3 and 1.4 = compounds of 1 molecule of SbCl₃ with 2, 3 and 4 molecules of aniline.

SbCl ₃ + Benzoic Acid.		SbCl ₃ + Benzoyl Chloride.		SbCl ₃ + Benzene Sulphonic Acid.		SbCl ₃ + Tetrahydrobenzene.	
t°.	Gms. SbCl ₃ per 100 Gms. Sat. Sol.	t°.	Gms. SbCl ₃ per 100 Gms. Sat. Sol.	t°.	Gms. SbCl ₃ per 100 Gms. Sat. Sol.	t°.	Gms. SbCl ₃ per 100 Gms. Sat. Sol.
120	0	-5	17.8	52.5 *	0	-25	19.1
110	23	-15	36.8	45	18	-15	24
100	38.8	-23 †	45	25	43.7	-5	30
90	50	-5	50.7	5	56.1	+5	37.1
80	59	+15	58.2	-5 †	60.8	15	45.1
70	66	25	62.9	+5	49.8	25	54.3
60	71.6	35	68.4	25	56.7	35	64.5
46 †	78	45	74.9	45	69.2	45	74
60	89.2	55	82.4	65	90.2	55	83.6
70	97.5	70	96.5	73	100	65	92.8

Molecular compounds are not formed in the above systems. The diagram in each case consists of two arms meeting at the eutectic.

* m. pt.

† Eutec.

‡ tr. pt.

RECIPROCAL SOLUBILITIES OF ANTIMONY TRICHLORIDE AND VARIOUS ORGANIC COMPOUNDS, DETERMINED BY THE "SYNTHETIC METHOD."
(Menschutkin, 1910-'11.)

SbCl₃ + Benzene.

t°.	Gms. SbCl ₃ per 100 Gms. Sat. Sol.	Solid Phase.
4 *	7.3	C ₆ H ₆
1	19.4	" + 2.1
10	24.6	2.1
20	30.5	"
40	44.1	"
60	60.6	"
75	76.8	"
79 †	85.3	"
70	93.5	"
62 *	96	2.1 + SbCl ₃
67.5	97.9	SbCl ₃

SbCl₃ + Brombenzene.

t°.	Gms. SbCl ₃ per 100 Gms. Sat. Sol.	Solid Phase.
-31 †	0	C ₆ H ₅ Br
-32.5 *	4.8	" + 1.1
-30	6.8	1.1
-20	14.8	"
-10	23.9	"
0	34.3	"
+ 3 †	40.3	1.1 + SbCl ₃
20	52	SbCl ₃
40	68	"
60	85.8	"
73	100	"

SbCl₃ + Chlorbenzene.

t°.	Gms. SbCl ₃ per 100 Gms. Sat. Sol.	Solid Phase.
-45.2 †	0	C ₆ H ₅ Cl
-47 *	4.3	" + 1.1
-40	7	1.1
-30	11.1	"
-15	20.5	"
-5	32.5	"
0 †	44.2	"
20	56	"
40	72.1	"
60	88.2	"
73	100	"

SbCl₃ + Fluorbenzene.

t°.	Gms. SbCl ₃ per 100 Gms. Sat. Sol.	Solid Phase.
-39.2 †	0	C ₆ H ₅ F
-40.5 *	2.4	" + 1.1
-25	11	1.1
-15	17.3	"
-10	21.4	"
-5	26.4	"
0	34.1	"
+ 5.5 †	45.8	1.1 + SbCl ₃
15	53.6	SbCl ₃
25	61.6	"
45	77.7	"
65	93.8	"

SbCl₃ + Iodobenzene.

t°.	Gms. SbCl ₃ per 100 Gms. Sat. Sol.	Solid Phase.
-28.6 †	0	C ₆ H ₅ I
-35	12.8	"
-45 *	29.8	" + 1.1
-34.5	11.7	1.1, unstable
-15	26.4	"
-3	49.1	"
-35	32.5	1.1 + SbCl ₃
-15	38.9	SbCl ₃
+ 5	46.4	"
25	56	"
45	69.6	"
65	88.8	"

SbCl₃ + Nitrobenzene.

t°.	Gms. SbCl ₃ per 100 Gms. Sat. Sol.	Solid Phase.
6 †	0	C ₆ H ₅ NO ₂
-2	20.4	"
-10	32	"
-16.5 *	38	" + 1.1
-10.5	44	1.1
-7.5	50	"
-6 †	64.8	"
-6.5 *	67.5	1.1 + SbCl ₃
+ 5	69.6	SbCl ₃
35	78.7	"
55	87.4	"
70	96.6	"

SbCl₃ + Ethylbenzene.

t°.	Gms. SbCl ₃ per 100 Gms. Sat. Sol.	Solid Phase.
-93 †	0	C ₆ H ₅ .C ₂ H ₅
-93.5 *	0.3	" + 1.1
-70	0.6	1.1
-50	1.1	"
-30	2.5	"
-10	7	"
+10	18.8	"
30	44.4	"
39 †	68.1	"
35 *	77.4	1.1 + 2.1
37 †	81.1	2.1
36.8 *	81.8	2.1 + SbCl ₃
50	87.2	SbCl ₃
70	98	"
...
33	80.4	1.1 + SbCl ₃ (unstable)

SbCl₃ + Benzonitrile.

t°.	Gms. SbCl ₃ per 100 Gms. Sat. Sol.	Solid Phase.
-13.2 †	0	C ₆ H ₅ CN
-16	10.2	"
-19 *	17.2	" + 1.1
-10	21.9	1.1
0	28.5	"
10	38.7	"
15	47.4	"
20	62.6	"
21.5 †	68.7	"
20	72.4	"
15 *	78.9	"
25	81.6	"
45	87.6	"
65	95.6	"
73	100	"

SbCl₃ + Isoamylbenzene.

t°.	Gms. SbCl ₃ per 100 Gms. Sat. Sol.	Solid Phase.
-80	4	1.1
-60	11.7	"
-40	25.4	"
-33 †	32.7	1.1 + 2.1
-25	38.7	2.1
-15	47.2	"
-5 †	56.8	2.1 + SbCl ₃
0	57.4	SbCl ₃
20	63.3	"
40	72.6	"
60	87.1	"
70	97.3	"
...
-25	44.4	unstable 1.1
-21 †	54.9	" 1.1 + SbCl ₃
-10	56	" SbCl ₃

* Eutec.

† m. pt.

† tr. pt.

1.1 = compound of equimolecular amounts of the two constituents in each case.
2.1 = compound of 2 molecules of SbCl₃ with 1 molecule of the other constituent.

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(Menschutkin, 1910-11.)

SbCl₃ + *m* Dinitrobenzene.

t°.	Gms. SbCl ₃ per 100 Gms. Sat. Sol.	Solid Phase.
90 *	0	<i>m</i> C ₆ H ₄ (NO ₂) ₂
80	18.6	"
70	31.3	"
60	40.7	"
50	48	"
40	53.6	"
30	58	"
20	61.5 unstable	"
10	64.5	"
1 †	66.8	" + SbCl ₃
-11	68.8	"
+27.5	52.5	" 1.1
28.5 *	58.2	"
27.5	63	"
25	67.5	"

SbCl₃ + Propylbenzene.

t°.	Gms. SbCl ₃ per 100 Gms. Sat. Sol.	Solid Phase.
70	0.6	2.1
-30	10.1	"
-10	26.6	"
0	40.4	"
7	57.5	"
8.5 †	68.2	" + SbCl ₃
20	71.4	SbCl ₃
40	78.5	"
65	92.5	"
...
-70	1.5 1.1	unstable
-30	16	"
-5	48.2	"
+1.5 *	65.3	"
1 †	66.3	" + SbCl ₃
10	68.6	SbCl ₃ "

SbCl₃ + *p* Dibromobenzene.

t°.	Gms. SbCl ₃ per 100 Gms. Sat. Sol.
88 *	0
85	5.7
80	15.4
70	35
60	52.8
55	59
49.5 †	64
65	71.8
60	79.3
70	95

SbCl₃ + *p* Dichlorobenzene.

t°.	Gms. SbCl ₃ per 100 Gms. Sat. Sol.
54.5 *	0
50	14
45	30
40	48
39.5 †	50.5
45	59.5
50	67.8
55	75.7
60	83
70	96.2

SbCl₃ + Cyclohexane.

t°.	Gms. SbCl ₃ per 100 Gms. Sat. Sol.	C1
6.4 *	0.0	
6 †	0.2	
20	1.2	
40	4.2	
60	9.7	
Two liquid layers formed		
70	13.7	97
80	19.5	96.1
100	32.3	92.7
120	57.1	83.2
124	58.9	76.7
125.5 §	68	

SbCl₃ + *p* Cymene.

t°.	Gms. SbCl ₃ per 100 Gms. Sat. Sol.	Solid Phase.
-75 *	0	<i>p</i> C ₆ H ₄ CH ₃ C ₆ H ₇
-76.5 †	2	" + 1.1
-50	7	1.1
-30	15	"
-10	30	"
-3.5 †	41	1.1 + 2.1
10	46.1	2.1
30	60	"
40 †	76.4	2.1 + SbCl ₃
50	81.2	"
60	87	"
70	95.6	"

SbCl₃ + Pseudocymene.

t°.	Gms. SbCl ₃ per 100 Gms. Sat. Sol.	Solid Phase.
-57.4 *	0	C ₆ H ₃ (CH ₃) ₃ 1, 2, 4
-60 †	18.6	" + 1.1
-45	23.6	1.1
-25	33.3	"
-10	45	"
-5 †	50.7	" + 2.1
+15	55.8	2.1
35	62.2	"
50	69.7	"
56 *	79.2	"
51 †	87.5	2.1 + SbCl ₃
65	93.9	SbCl ₃

SbCl₃ + Diphenyl.

t°.	Gms. SbCl ₃ per 100 Gms. Sat. Sol.	Solid Phase.
70.5 *	0	C ₆ H ₅ ·C ₆ H ₅
65	14	"
55	33.4	"
50 †	40	" + 2.1
55	45.2	2.1
60	51.4	"
70	70.7	"
71 *	74.6	"
65	85.5	"
57 †	88.9	2.1 + SbCl ₃
65	93.1	SbCl ₃
70	97	"

* m. pt.

† Eutec.

‡ tr. pt.

§ crit. t.

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(Menschutkin, 1910-11.)

SbCl₃ + Mesitylene.

t°.	Gms. SbCl ₃ per 100 Gms. Sat. Sol.	Solid Phase.
-54.4 *	0	C ₆ H ₃ (CH ₃) ₃ 1, 3, 5
-55.6	1.5	" +1.1
-40	3	1.1
-20	7	"
0	14.2	"
10	20.3	"
30	39.3	"
38 †	51.4	" +2.1
65	65.4	2.1
75.5 *	79.2	"
70	87	"
58.5	92.4	" +SbCl ₃
63	94	SbCl ₃
70	98	"

SbCl₃ + Diphenyl Methane.

t°.	Gms. SbCl ₃ per 100 Gms. Sat. Sol.	Solid Phase.
26 *	0	CH ₂ (C ₆ H ₅) ₂
22.5 †	7.9	" +2.1
40	15.1	2.1
60	26	"
70	33	"
80	41.6	"
90	52.7	"
95	59.8	"
100 *	72.9	"
95	82.2	"
90	86.7	"
80	91.5	"
67 †	95.7	2.1+SbCl ₃
70	97	SbCl ₃

SbCl₃ + Triphenyl Methane.

t°.	Gms. SbCl ₃ per 100 Gms. Sat. Sol.	Solid Phase.
92 *	0	CH(C ₆ H ₅) ₃
85	11.8	"
80	19.3	"
70	32	"
60	42.4	"
50	49.6	"
49 †	50	" +1.1
45	62.8	1.1
40	68.3	"
35 †	72	1.1+SbCl ₃
35	76.6	SbCl ₃
55	82.4	"
65	90.6	"
70	96.1	"

SbCl₃ + Naphthalene.

t°.	Gms. SbCl ₃ per 100 Gms. Sat. Sol.	Solid Phase.
79.4 *	0	C ₁₀ H ₈
75	15.2	"
65	35	"
59 †	42.8	" +2.1
65	48.4	2.1
75	58.8	"
80	65	"
86 *	78	"
80	88.7	"
70	93	"
65 †	94	2.1+SbCl ₃
70	97.2	SbCl ₃

SbCl₃ + α Chlor-naphthalene.

t°.	Gms. SbCl ₃ per 100 Gms. Sat. Sol.	Solid Phase.
-17 *	0	α C ₁₀ H ₇ Cl
-21 †	8.1	" +2.1
0	14.4	2.1
10	18.7	"
20	24.6	"
30	33.5	"
40	47.7	"
45	61.5	"
46 *	73.6	"
45.5 †	75	2.1+SbCl ₃
55	82.2	SbCl ₃
70	96.5	"

SbCl₃ + β Chlor-naphthalene.

t°.	Gms. SbCl ₃ per 100 Gms. Sat. Sol.	Solid Phase.
56	0	β C ₁₀ H ₇ Cl
50	16.6	"
45	27.2	"
40	35.4	"
30	47.3	"
25 †	52.3	" +1.1
29.5 *	58.2	1.1
28 †	64	1.1+SbCl ₃
35	68.3	SbCl ₃
45	75.3	"
60	87.5	"
73	100	"

SbCl₃ + α Bromnaphthalene.

t°.	Gms. SbCl ₃ per 100 Gms. Sat. Sol.	Solid Phase.
3 *	0	α C ₁₀ H ₇ Br
-1 †	8.3	" +1.1
10	12.8	1.1
25	24	"
33	38.5	"
34.5 *	52.4	"
33	62.1	"
31.5 †	64.7	1.1+SbCl ₃
40	69.7	SbCl ₃
50	76.2	"
60	84.5	"
70	94.8	"

SbCl₃ + α Nitronaphthalene.

t°.	Gms. SbCl ₃ per 100 Gms. Sat. Sol.	Solid Phase.
57 *	0	α C ₁₀ H ₇ NO ₂
50	13.6	"
40	27.3	"
30 †	35.8	" +1.1
35	43.2	1.1
37.5	49.3	"
39 *	56.7	"
37.5	64.9	"
34.5 †	72.8	1.1+SbCl ₃
45	78	SbCl ₃
60	87.4	"
70	96.6	"

* m pt.

† tr. pt.

‡ Eutec.

1.1 = compound of equimolecular amounts of the two constituents in each case.

2.1 = compound of 2 molecules of SbCl₃ with 1 molecule of the other constituent.

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(Menschutkin, 1910-12.)

SbCl ₃ + Phenol.			SbCl ₃ + Phenetol.			SbCl ₃ + Toluene.		
t°.	Gms. SbCl ₃ per 100 Gms. Sat. Sol.	Solid Phase.	t°.	Gms. SbCl ₃ per 100 Gms. Sat. Sol.	Solid Phase.	t°.	Gms. SbCl ₃ per 100 Gms. Sat. Sol.	Solid Phase.
41 *	0	C ₆ H ₅ OH	-28.6 *	0	C ₆ H ₅ OC ₂ H ₅	-93 *	0	C ₆ H ₅ .CH ₃
35	16.2	"	-29 †	1.4	" + 1.1	-94 †	1.1	" + 1.1
30	25.6	"	-20	4.5	1.1	-70	3.1	1.1
20	38.7	"	-10	8.1	"	-30	15.8	"
10	48	"	+10	18.2	"	0	41.5	"
5 †	52	" + 2.1	20	27.4	"	11 †	57.8	" + 2.1
15	58.6	2.1	30	39.4	"	20	62.8	2.1
30	70.6	"	40	58	"	40	78	"
37 *	83	"	42.2 *	65	"	42.5 *	83.1	"
36.5 †	83.7	2.1 + SbCl ₃	35 †	77.8	"	40 †	85.8	2.1 + SbCl ₃
55	90.6	SbCl ₃	50	86.8	"	50	89	SbCl ₃
70	98.2	"	70	97.1	"	70	97.8	"

SbCl ₃ + o Chlortoluene.			SbCl ₃ + m Chlortoluene.			SbCl ₃ + p Chlortoluene.		
t°.	Gms. SbCl ₃ per 100 Gms. Sat. Sol.	Solid Phase.	t°.	Gms. SbCl ₃ per 100 Gms. Sat. Sol.	Solid Phase.	t°.	Gms. SbCl ₃ per 100 Gms. Sat. Sol.	Solid Phase.
-36.2 *	0	o C ₆ H ₄ .CH ₃	-47.8 *	0	m C ₆ H ₄ .CH ₃	6.2 *	0	p C ₆ H ₄ .CH ₃
-37.5 †	6.9	" + 1.1	-49 †	6.9	" + 1.1	3	12.7	"
-20	18.3	1.1	-40	12.3	1.1	0	23.5	"
-10	29.2	"	-30	20.1	"	-3	32.2	"
-5	37.1	"	-20	31	"	-7.5 †	43.8	" + SbCl ₃
-0.5 †	47.9	1.1 + SbCl ₃	-14 †	40	1.1 + SbCl ₃	0	47.2	SbCl ₃
+10	53.1	SbCl ₃	0	46.1	SbCl ₃	10	52.2	"
20	58.2	"	10	51.6	"	30	64.8	"
30	64.6	"	20	57.4	"	40	72.3	"
40	71.8	"	40	72.8	"	50	80.2	"
60	88.4	"	60	89.1	"	60	88.8	"
73	100	"	73	100	"	70	97.4	"

SbCl ₃ + o Nitrotoluene.			SbCl ₃ + m Nitrotoluene.			SbCl ₃ + p Nitrotoluene.		
t°.	Gms. SbCl ₃ per 100 Gms. Sat. Sol.	Solid Phase.	t°.	Gms. SbCl ₃ per 100 Gms. Sat. Sol.	Solid Phase.	t°.	Gms. SbCl ₃ per 100 Gms. Sat. Sol.	Solid Phase.
-8.5 *	0	o NO ₂ C ₆ H ₄ .CH ₃	16 *	0	m NO ₂ C ₆ H ₄ .CH ₃	52.5 *	0	p NO ₂ C ₆ H ₄ .CH ₃
-13.5	11.3	"	10	15	"	45	18.5	"
-18.5 †	18.5	" + 1.1	0	30.7	"	35	33.6	"
-10	21.3	1.1	-10	39.2	"	30	38.8	"
+10	31.1	"	-20	42.8	"	20	46	"
20	39	"	crystallization not obtained here			7.5 †	52	" + 1.1
30	50	"				7.5 *	62.3	1.1
34.5 *	62.3	"	0	67.2	SbCl ₃	5	66.1	"
33	68	"	20	72.5	"	3 †	68.5	1.1 + SbCl ₃
27.5 †	74.6	" + SbCl ₃	30	76.3	"	10	70	SbCl ₃
40	79.1	SbCl ₃	40	80.8	"	30	75.5	"
50	84.5	"	50	86	"	50	85	"
70	97.5	"	60	91.6	"	70	97.5	"
			73	100	"			

* m. pt.

† Eutec.

‡ tr. pt.

1.1 = compound of equimolecular amounts of the two constituents in each case.

2.1 = compound of 2 molecules of SbCl₃ with 1 molecule of the other constituent.

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(Menschutkin, 1910.)

SbCl ₃ + <i>o</i> Xylene.			SbCl ₃ + <i>m</i> Xylene.			SbCl ₃ + <i>p</i> Xylene.		
t°.	Gms. SbCl ₃ per 100 Gms. Sat. Sol.	Solid Phase.	t°.	Gms. SbCl ₃ per 100 Gms. Sat. Sol.	Solid Phase.	t°.	Gms. SbCl ₃ per 100 Gms. Sat. Sol.	Solid Phase.
-29	0	<i>o</i> C ₆ H ₄ (CH ₃) ₂	-57 *	0	<i>m</i> C ₆ H ₄ (CH ₃) ₂	14 *	0	<i>p</i> C ₆ H ₄ (CH ₃) ₂
-35 †	14	" +1.1	-60.5 †	7.5	" +1.1	11.7 †	11.7	" +1.1
-30	17.5	1.1	-45	15.8	1.1	20	17.5	1.1
-20	24.8	"	-25	29	"	40	37.3	"
-10	33.4	"	-5	46.2	"	50	52.3	"
0	43.4	"	-2 †	49.8	" +2.1	55 †	62.7	" +2.1
10	55	"	5	53.1	2.1	60	66.1	2.1
19.5 *	68.1	"	15	58.7	"	70 *	81	"
25	71.3	2.1	25	65.7	"	65	88.1	"
30	75.7	"	33	73.8	"	58 †	92	" +SbCl ₃
33.5 *	81	"	38 *	81	"	69	97.2	SbCl ₃
31.5 †	82.5	2.1+SbCl ₃	36.5 †	83.7	2.1+SbCl ₃	...	...	...
50	88	SbCl ₃	50	87.7	SbCl ₃	10	20.7 †	<i>p</i> C ₆ H ₄ (CH ₃) ₂ unstable
60	92.4	"	60	91.5	"	7 †	32.8	" +2.1 "
71	98.5	"	70	97.2	"	35	50.3	2.1 "
						55	62.7	" "

* m. pt.

† Eutec.

‡ tr. pt.

1.1 = compound of equimolecular amounts of the two constituents in each case.

2.1 = compound of 2 molecules of SbCl₃ with 1 molecule of the other constituent.

DISTRIBUTION OF ANTIMONY TRI AND PENTACHLORIDES BETWEEN AQUEOUS HCl AND ETHER AT ROOM TEMPERATURE

(Mylus, 1911)

When 1 gm. of antimony as SbCl₃ or as SbCl₅ is dissolved in 100 cc. of aq. HCl of the following strengths and the solution shaken with 100 cc. of ether, an amount of metal, depending upon the concentration of the aq. acid solution, enters the ethereal layer.

With 1% SbCl₃ Solution.

Per cent Conc. of HCl.	Per cent of Total Sb in Ether Layer.
20	6
15	13
10	22
5	8
1	0.3

With 1% SbCl₅ Solution.

Per cent Conc. of HCl.	Per cent of Total Sb in Ether Layer.
20	81
15	22
10	6
5	2.5
1	trace

Fusion-point data are given for:

SbCl ₃ + SbCl ₅ (1)	SbCl ₃ + Azobenzene (4)
" + SbI ₃ (2)	" + Benzil (4)
" + " † SbBr ₃ (2)	" + <i>s</i> di phenyl ethane (4)
" + SnCl ₂ (3)	" + Stilbene (4)
" + SnCl ₄ (3)	" + Benzanilide (6)
" + Benzene (5)	" + Benzaniline (6)
" + Naphthalene (5)	" + β Chlor Naphthalene (7)
" + Di phenyl Methane (5)	" + α Nitro Naphthalene (7)
" + Tri phenyl Methane (5)	

(1) Aten, 1909; (2) Bernadis, 1912; (3) Kendall, Crittenden and Muller, 1923; (4) Vanstone, 1914; (5) Kurnakov, Krotkov and Oksman, 1915; (6) Vanstone, 1925; (7) Vasiliev, 1917.

ANTIMONY PentaCHLORIDE SbCl_5 .

Data for the freezing-points of mixtures of antimony pentachloride and antimony pentafluoride are given by Ruff (1909).

ANTIMONY OxyCHLORIDE $\text{Sb}_4\text{O}_5\text{Cl}_2$.

SOLUBILITY IN AQUEOUS SOLUTIONS OF HYDROCHLORIC ACID AT 23°.
(Lea and Wood, 1924.)

Hydrated antimonious oxide was added in excess to solutions of pure HCl of varying concentrations and the mixtures kept in a thermostat for two months. They were shaken from time to time by hand. Portions were removed for analysis and after another month other portions were removed for a duplicate analysis. The results agreed satisfactorily, thus indicating that equilibrium had been reached. The results gave a smooth curve, thus showing the absence of a transition point. The solid phase gradually took on a crystalline appearance and on analysis corresponded to $\text{Sb}_4\text{O}_5\text{Cl}_2$.

Gm. atoms per liter of sat. sol.		Gm. atoms per liter of sat. sol.		Gm. atoms per liter of sat. sol.	
Cl.	Sb.	Cl.	Sb.	Cl.	Sb.
0.194	0.00012	1.56	0.0116	2.81	0.177
0.402	0.000172	1.74	0.0194	3.36	0.309
0.601	0.000298	1.90	0.0299	3.85	0.440
0.799	0.000610	2.10	0.0522	4.79	0.745
1.02	0.00124	2.29	0.0755	5.93	1.13
1.32	0.00565	2.54	0.120		

ANTIMONY TriFLUORIDE SbF_3 .

SOLUBILITY IN WATER.
(Rosenheim and Grünbaum, 1909.)

t°.	Gms. SbF_3 per 100 Gms.	
	Water.	Sat. Solution.
0	384.7	79.4
20	444.7	81.6
22.5	452.8	81.9
25	492.4	83.1
30	563.6	84.9

SOLUBILITY IN AQUEOUS SOLUTIONS OF SALTS AND OF HYDROFLUORIC ACID AT 0°.

Normality of Aq. Salt Solution.	Gms. SbF ₃ per 100 Gms. H ₂ O present in Aq. Solutions of:							
	KCl.	KBr.	KNO ₃ .	K ₂ SO ₄ .	K ₂ C ₂ O ₄ .	(NH ₄) ₂ C ₂ O ₄ .	K ₂ C ₄ H ₄ O ₆ .	HF.
I	461.8	448.7	458.2	419.9	465.7	...	461.4	432.5
0.5	448.3	450	451.9	408.5	481.2	431.9	430.5	404
0.25	431.9	455.6	418.3	406.6	451.3	442.3	430.8	...
0.125	407.3	417.2	401.4	...	405.2	433.3	435.2	*479.4

* (2 \approx HF.)

Celluloid flasks were used and all measuring apparatus provided with HF resistant coating. The SbF_3 was prepared in the form of rhombic transparent crystals from Sb_2O_3 and HF.

ANTIMONY Tri IODIDE SbI_3 .

EQUILIBRIUM IN THE SYSTEM ANTIMONY TRI IODIDE, AMMONIUM IODIDE AND WATER.
(Francois, 1935.)

The results are presented only in the form of a diagram from which the following values were read.

Gms. per 100 gms. H_2O			Solid Phase	Gms. per 100 gms. H_2O			Solid Phase	Gms. per 100 gms. H_2O			Solid Phase
SbI_3	NH_4I			SbI_3	NH_4I			SbI_3	NH_4I		
Results at 11°				Results at 20°				Results at 50°			
0.0	165	NH_4I		0.0	172	NH_4I		0.0	200	NH_4I	
20.0	178	"		40.0	195	"		70.0	233	"	
40.0	188	"		55.0	210	" + 1.4.3		128	270	" + 1.4.3	
55.0	198	" + 1.4.3		100	205	1.4.3		140	266	1.4.3	
65.0	194	1.4.3		136	215	" + ?		145	270	" + 1.2.2	
85.0	192	"		142	212	? + 1.2.2		120	200	1.2.2	
110.0	194	" + ?		120	180	1.2.2		Results at 75°			
114.0	185	?		100	130	"		0.0	224	NH_4I	
118.0	180	" + 1.1.2		Results at 35°				70.0	255	"	
105.	160	1.2.2		0.0	185	NH_4I		143	295	" + 1.2.2	
90.	130	"		95.0	234	"		120	205	1.2.2	
1.4.3 = $\text{SbI}_3 \cdot 4\text{NH}_4\text{I} \cdot 3\text{H}_2\text{O}$				120.	227	1.4.3					
1.2.2 = $\text{SbI}_3 \cdot 2\text{NH}_4\text{I} \cdot 2\text{H}_2\text{O}$				148	243	" + 1.2.2					
				105	160	1.2.2					

EQUILIBRIUM IN THE SYSTEM ANTIMONY TRI IODIDE SODIUM IODIDE AND WATER.
(Francois, 1935.)

The results are presented only in the form of a diagram from which the following approximate values were read.

Gms. per 100 gms. H_2O			Solid Phase	Gms. per 100 gms. H_2O			Solid Phase
SbI_3	NaI			SbI_3	NaI		
Results at 15°				Results at 60°			
0.0	174	NaI		0.0	257	NaI	
10	178	" + 1.2.8		50	263	"	
20	130	1.2.8		85	270	" + 1.2.8	
50	100	"		75	220	1.2.8	
58	90	" + 1.1.6		100	155	"	
70	60	1.1.6		130	140	"	
Results at 35°				165	140	" + 1.1.6	
0.0	197	NaI		170	120	1.1.6	
25.0	200	" + 1.2.8		200	105	" + SbI_3	
40	135	1.2.8		150	85	SbI_3	
70	110	"		100	50	"	
95	100	" + 1.1.6		55	25	"	
105	80	1.1.6					

1.2.8 = $\text{SbI}_3 \cdot 2\text{NaI} \cdot 8\text{H}_2\text{O}$; 1.1.6 = $\text{SbI}_3 \cdot \text{NaI} \cdot 6\text{H}_2\text{O}$.

100 gms. Methylene Iodide, CH_2I_2 , dissolve 11.3 gms. SbI_3 at 12° and the density of the solution is 3.453. (Retgers, 1893.)

Fusion-point data are given for:

- $\text{SbI}_3 + \text{AsI}_3$ (Vasilev, 1912, 1921; Quercigh, 1912; Jaeger and Dornbosch, 1912.)
 " + P_2O_3 (Jaeger and Dornbosch, 1912.)
 " + I_2S_3 (Quercigh, 1912.)
 " + SnI_3 (Vasilev, 1921.)

ANTIMONY TriOXIDE Sb_2O_3 .

Freezing-point data are given for mixtures of antimony trioxide and antimony trisulfide. (Quercigh, 1912.)

ANTIMONY Tri SULFIDE Sb_2S_3 .

1000 cc water dissolve 0.00175 gm. Sb_2S_3 at 18° . (Weigel, 1907.)

SOLUBILITY OF ANTIMONY TRI SULFIDE IN AQUEOUS SOLUTIONS OF AMMONIA. (Bpk. 1932.)

The determinations were made by warming mixtures of sulfide and aqueous ammonia of different concentrations for five minutes over a Bunsen burner. The solutions thus obtained were analyzed for antimony and residual ammonia.

Percent concentration of NH_3 in solvent		Gas. Sb_2S_3 dissolved per 100 cc solvent
at beginning	at end	
1.0	0.88	0.127
2.0	1.7	0.206
5.0	4.0	0.420
10.0	7.4	0.730
15.0	9.2	0.870
25.0	13.4	1.280

S

The effect of time of heating and variation in excess of sulfide were studied. The gms. of sulfide per 100 cc of solvent was found to increase from 0.58 to 0.73 when the amount of sulfide per 1 gm. of NH_3 in the original solution varied from 0.05 to 0.15.

Fusion-point data are given for:

- $\text{Sb}_2\text{S}_3 + \text{CuS}$ (Parravano and Cesaris, 1912.)
 " + SnS " " "
 " + Ag_2S (Jaeger and Van Klooster, 1912; Konno, 1919; Pelabon, 1913; Jitsuka, 1919.)
 " + PbS " " "
 " + BiS (Takahashi, 1919.)

ANTIMONY Tri Phenyl SULFIDE $\text{Sb}(\text{C}_6\text{H}_5)_3\text{S}$.

Fusion-point data are given by Pascal, 1923, for:

- $\text{Sb}(\text{C}_6\text{H}_5)_3\text{S} + \text{PO}(\text{C}_6\text{H}_5)_3$ (Tri phenyl phosphine oxide.)
 " + $\text{PS}(\text{C}_6\text{H}_5)_3$ (Tri phenyl phosphine sulfide.)
 " + $\text{AsS}(\text{C}_6\text{H}_5)_3$ (Tri phenyl arsine sulfide.)
 " + $\text{AsO}(\text{C}_6\text{H}_5)_3$ (Tri phenyl arsine oxide.)

ANTIMONY SELENIDES SbSe , Sb_2Se_3 .

Fusion-point data are given by Pelabon, 1908, for:

- $\text{SbS} + \text{Ag}_2\text{Se}$ and $\text{Sb}_2\text{Se}_3 + \text{AgSe}$.

SCANDIUM OXALATE $\text{Sc}_2(\text{C}_2\text{O}_4)_3 \cdot 5\text{H}_2\text{O}$.

SOLUBILITY IN AQUEOUS SOLUTIONS OF AMMONIUM OXALATE AND OF HYDROCHLORIC ACID.

In Aq. Ammonia Oxalate at 25°. (Wirth, 1914.)			In Aq. Hydrochloric Acid at 25° and at 50°. (Meyer, 1914.)		
Gms. per 100 Gms. Sat. Sol.		Solid Phase.	Normality of Aq. HCl.	Gms. $\text{Sc}_2(\text{C}_2\text{O}_4)_3$ per 100 Gms. Sat. Sol.	
C_2O_3 .	Sc_2O_3 .			At 25°.	At 50°.
1.624	0.3019	$\text{Sc}_2(\text{C}_2\text{O}_4)_3 \cdot 5\text{H}_2\text{O}$	0.1	0.0299	0.0420
2.4	0.4012	"	0.5	0.0650	0.0870
4.478	0.7108	" + $(\text{NH}_4)_2\text{C}_2\text{O}_4$	1	0.1020	0.1435
			2	0.1716	0.2556
			5	0.4170	0.6533

SOLUBILITY IN AQUEOUS SOLUTIONS OF SULFURIC ACID.

Results at 25°. (Wirth, 1914.)			Results at 25° and at 50°. (Meyer, 1914.)		
Normality of Aq. H_2SO_4 .	Gms. $\text{Sc}_2(\text{C}_2\text{O}_4)_3$ per 100 Gms. Sat. Sol.	Solid Phase.	Normality of Aq. H_2SO_4 .	Gms. $\text{Sc}_2(\text{C}_2\text{O}_4)_3$ per 100 Gms. Sat. Sol.	
				At 25°.	At 50°.
1	0.1148	$\text{Sc}_2(\text{C}_2\text{O}_4)_3 \cdot 5\text{H}_2\text{O}$	0.1	0.0385	0.0562
2.1	0.2573	"	0.5	0.0997	0.1481
2.43	0.2904	"	1	0.1663	0.2493
3.57	0.4204	"	2	0.3176	0.4429
4.86	0.5834	"	5	0.7761	1.1280

100 gms. sat. solution of scandium oxalate in 2.43 n H_2SO_4 + 0.5 n oxalic acid contain 0.0284 gm. Sc_2O_3 at 25°. (Wirth, 1914.)

SCANDIUM SULFATE $\text{Sc}_2(\text{SO}_4)_3 \cdot 5\text{H}_2\text{O}$.

SOLUBILITY IN WATER AND IN AQUEOUS SULFURIC ACID AT 25°. (Wirth, 1914.)

Solvent.	Gms. $\text{Sc}_2(\text{SO}_4)_3$ per 100 Gms. Sat. Sol.	Solid Phase.	Solvent.	Gms. $\text{Sc}_2(\text{SO}_4)_3$ per 100 Gms. Sat. Sol.	Solid Phase.
Water	28.52		4.86 n H_2SO_4	8.363	
0.5 n H_2SO_4	29.29	"	9.73 n H_2SO_4	1.315	"
1 n H_2SO_4	19.87	"	22.35 n H_2SO_4	0.484	$\text{Sc}_2(\text{SO}_4)_3 \cdot 3\text{H}_2\text{O}$

Scandium sulfuric acid double sulfate, $\text{Sc}_2(\text{SO}_4)_3 \cdot 3\text{H}_2\text{SO}_4$. 100 gms. sat. sol. in conc. H_2SO_4 of $d = 1.6$ contain 0.8616 gm. of the double salt. (Wirth, 1914.)

100 cc. of aq. 66 % KOH solution dissolve 9.19 gms. Se. This corresponds to an atomic ratio of 39.15 gm. atoms K : 14.91 gms. atoms Se, which shows that not all of the selenium is in the form of selenide.

100 cc. of aq. 66 % NaOH solution dissolve 2.45 gms. Se.

100 cc. of sat. aq. Ba (OH)₂ solution dissolve 2.65 gms. Se after being kept several days at 80°.

(Calcagni, 1923.)

SOLUBILITY OF SELENIUM IN CARBON DISULFIDE. (Moles and Jimeno, 1915.)

Carefully prepared amorphous red selenium was used. The saturated solutions were analyzed by evaporating at ordinary temperature and weighing the residue after heating to 110°. The solubility of selenium varies with the time which elapses after its preparation and with the time of exposure to light. Amorphous selenium in contact with carbon disulfide is transformed to crystalline selenium. The variations in solubility are probably due to this transformation. It is necessary to admit the existence of many varieties of red crystalline selenium with different solubilities. These varieties owe their origin to the action of the solvent or of light and may be identical with the two monoclinic modifications studied by Muthmann. Some of the solubility results obtained by the authors are as follows :

t°.	Gms. Se per 100 gms. Se + CS ₂ .	Conditions of the determination.				
?	0.0573	Solubility	1 hour	after preparation	of sample	
?	0.0475	"	24 hours	"	"	"
?	0.0190	"	1436	"	"	"
3.	0.00191	Solution prepared in the dark : 3 hours				
12.	0.00247	"	"	"	"	"
12.	0.00662	"	"	"	"	72 "
9.	0.0251	Same solution after 48 hours exposure to sunlight				
44.	0.1586	Solution in boiling CS ₂				
0.	0.0184	The above solution cooled for 20 hours				

100 gms. selenium monochloride saturated with selenium by shaking in a thermostat at 25° for a very long time contain 9.73 gms. Se. (Lenher and Kao, 1926.)

SOLUBILITY IN CARBON DISULFIDE.

(Marc, 1906.)

100 cc. CS₂ dissolve 0.065 gm. amorphous Se at room temperature. Se which is heated to 180° for 6-7 hours is insoluble in CS₂. Se crystallized from the melt at 200° is insoluble in CS₂. Se heated once quickly to 140° is very slightly soluble in CS₂.

100 cc. CS₂ dissolve at the boiling-point 3-3.4 mgs. Se which has been heated to 140° for 1 hr.

100 cc. CS₂ dissolve at the boiling-point 2 mgs. Se which has been heated to 195° for 2 days.

(Marc, 1907.)

100 gms. methylene iodide (CH₂I₂) dissolve 1.3 gms. Se at 12°. (Retgers, 1893.)

SOLUBILITY OF MIX CRYSTALS OF SELENIUM AND SULFUR IN CARBON DISULFIDE

AT 25°. (Ringer, 1902.)

Mols. per 100 Mols. Solution.			Mol. Per Cent Se in Crystals.	Mols. per 100 Mols. Solution.			Mol. Per Cent Se in Crystals.
CS ₂ .	Se.	S.		CS ₂ .	Se.	S.	
43.1	0	56.9	0	58.24	2.35	39.41	55.67
45.1	0.93	53.97	3.54	64.66	1.58	33.76	68.38
44.98	1.03	53.99	3.81	81.11	2.4	16.49	58.7
47.84	2.07	50.59	8.69	88.41	2.17	9.42	61.5
49.54	2.19	48.27	16.4*	91.38	1.68	6.94	65
47.62	2.16	50.22	14.2*	99.51	0.49	0	100†
46.12	1.485	52.39	29.35*	99.14	0.86	0	100†

* Mix crystals homogeneous in all except these solutions.

† = Solubility of hexagonal selenium.

† = Solubility of amorphous selenium.

Fusion-point curves for mixtures of selenium and other metals are given by Pelabon (1909). Results for Se + Te are given by Pellini and Vio (1906).

Freezing-point data for mixtures of Se + S, Se + Te and Se + S + Te are given by Losana, 1923.

Diphenyl SELENIUM BROMIDE $(C_6H_5)_2SeBr_2$.

RECIPROCAL SOLUBILITY OF DIPHENYL SELENIUM BROMIDE AND DIPHENYL TELLURIUM BROMIDE IN WATER AT 25°.
(Pellini, 1906a.)

Gms. per 1000 cc. Sat. Sol.		Mol. % $(C_6H_5)_2SeBr_2$ in Cryst. Mixture.	Gms. per 1000 cc. Sat. Sol.		Mol. % $(C_6H_5)_2TeBr_2$ in Cryst. Mixture.
$(C_6H_5)_2TeBr_2$	$(C_6H_5)_2SeBr_2$		$(C_6H_5)_2TeBr_2$	$(C_6H_5)_2SeBr_2$	
18.614	0	0	10.224	14.608	44.89
17.400	1.448	4.91	7.544	19.876	51.18
16.152	4.172	10.51	6.780	18.984	94.25
15.030	6.210	18.21	3.184	17.392	95.82
13.320	8.148	24.98	0	18.984	100
11.940	11.420	34.94			

SELENIUM DIOXIDE $SeO_2 \cdot H_2O$.

SOLUBILITY OF SELENIUM DIOXIDE IN WATER, DETERMINED BY THE FREEZING-POINT METHOD. (Manchot and Ortnier, 1922.)

0	Gms. SeO_2			Gms. SeO_2		
	t°.	per 100 gms. sat. sol.	Solid Phase.	t°.	per 100 gms. sat. sol.	Solid Phase.
	— 0.2.....	0.99	Ice	— 20.....	53.60	Ice
	— 1.1.....	4.88	»	— 23 (eutec.).	57.00	» + $SeO_2 \cdot H_2O$
	— 5.0.....	21.83	»	— 21.....	58.0	$SeO_2 \cdot H_2O$
	— 8.2.....	33.00	»	— 12.5....	61.6	»
	— 9.9.....	37.64	»	— 7.0....	63.4	»
	— 11.3.....	40.65	»	+ 7.0....	68.32	»
	— 13.0....	44.00	»	22.0....	72.52	»
	— 14.9.....	47.03	»	42.0....	77.50	»
	— 16.5.....	49.10	»	65.0....	82.50	»

Results for the system SeO_2 + HBr between 0° and 30° are given by Parker and Robinson, 1931.

SOLUBILITY OF SELENIUM DIOXIDE IN SEVERAL SOLVENTS.

(de Coninck, 1906.)

Solvent.	t°.	Gms. SeO_2 per 100 cc. Solvent.
Water	11.3–15	38.5
Ethyl Alcohol (93%)	14.1	10.2
Methyl Alcohol	11.8	6.66
Acetone	15.3	4.35
Acetic Acid (Glacial)	12.9	1.11

SOLUBILITY IN LEAD, IN ZINC AND IN SILVER.

(Moissan and Siemens, 1904.)

In Lead.		In Zinc.		In Silver.	
t°.	Gm. Si per 100 Gms Lead.	t°.	Gm. Si per 100 Gms. Zinc.	t°.	Gm. Si per 100 Gms. Silver.
1250	0.024	600	0.06	970	9.22 (58.02)
1330	0.070	650	0.15	1150	14.89 (27.66)
1400	0.150	730	0.57	1250	19.26 (19)
1450	0.210	800	0.92	1470	41.46 (16)
1550	0.780	850	1.62		

The silicon which crystallized from the saturated solution in silver was found to be incompletely soluble in HF. The figures in parentheses show the percentage soluble in HF in each case.

Freezing-point data for mixtures of silicon tetraphenyl and tin tetraphenyl are given by Pascal (1912).

SILICON Tetra BROMIDE SiBr_4 .

Fusion-point data are given for $\text{SiBr}_4 + \text{SiCl}_2$ and $\text{SiBr}_4 + \text{SiI}_4$ by Raeder, 1933.

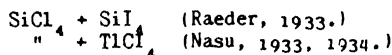
SILICON Tetra CHLORIDE SiCl_4 .

RECIPROCAL SOLUBILITY OF SILICON TETRA CHLORIDE AND SULFUR DIOXIDE, DETERMINED BY THE SYNTHETIC METHOD.

(Bond and Stephens, 1929.)

t°	Gms. SiCl_4 per 100 gms. mixture	t°	Gms. SiCl_4 per 100 gms. mixture	t°	Gms. SiCl_4 per 100 gms. mixture
-76.5	1.09	-16.6	19.34	-6.3	72.07
-77.0	1.97	-12.9	23.18	-12.8	83.12
-79.1	1.97	-9.2	28.75	-20.1	88.46
-70.2	2.83	-8.1	30.67	-38.6	94.66
-57.0	4.36	-6.1	37.44	-46.9	96.03
-46.6	6.33	-5.1	45.29	-72.4	98.70
-38.4	8.35	-4.9	52.55	-77.0	98.84
-32.4	10.27	-4.8	56.71	-79.2	98.84
-27.5	12.37	-4.8	60.72	-76.5	98.98
-22.0	15.40	-5.5	68.00	-67.7	100.00

Fusion-point data for:

SILICON Tetra FLUORIDE SiF_4 .

SOLUBILITY OF SILICON TETRA FLUORIDE IN ORGANIC SOLVENTS AT 27-33° AND A TOTAL PRESSURE OF 750-760mm.

(Tarbutton, Egan and Frary, 1939.)

Solvent	Gms. SiF_4 per 100		Solvent	Gms. SiF_4 per 100	
	cc solvent	gms. sat. sol.		cc solvent	gms. sat. sol.
Methyl Alcohol (abs.)	—	32.8	Amyl Alcohol	20.9	17.3
Ethyl " (96.1wt.%)	—	39.0	Glycol	—	26.2
" " (abs.)	57.2	36.4	Di ethylene glycol	—	17.6
" " (96.1wt.%)	60.8	37.8	Glycerol	—	5.7
" " (94.3wt.%)	61.5	38.1	Acetone (anhydrous)	3.2	3.1
" " (92.6wt.%)	63.4	38.8	Acetic Acid		
" " (91.0wt.%)	63.9	39.0	(glacial)	1.1	1.1

SILICON Potassium Hexa FLUORIDE SiK_2F_6 .

100 cc. sat. sol. of silicon potassium hexafluoride in water contain 0.00544 gm. SiK_2F_6 at 17°. (von Hevesy, Christiansen and Berglund, 1925.)

SILICON IODIDES Si_2I_6 , SiI_4 .

SOLUBILITY IN CARBON DISULFIDE.
(Friedel and Lachburg, 1869; Friedel, 1869.)

100 gms. CS_2 dissolve 19 gms. Si_2I_6 at 19°.
100 gms. CS_2 dissolve 26 gms. Si_2I_6 at 27°.
100 gms. CS_2 dissolve 2.2 gms. SiI_4 at 27°.

SILICA SiO_2 .

SOLUBILITY IN WATER AND IN AQUEOUS SOLUTIONS OF ACIDS.
(Lenher and Merrill, 1917.)

A platinum bottle and stirrer were used. The silica was prepared by adding silicon tetrachloride to water. The gel thus formed was washed until free of HCl and dried between filter papers. Conductivity water was used and equilibrium was reached within 24 hours. The saturated solution was evaporated to dryness in a platinum dish. The residue was weighed and the silica volatilized with $\text{HFl} + \text{H}_2\text{SO}_4$. The difference was considered to show "the amount of silica which had changed from an unfilterable to a filterable state of division."

Results for Aq. HCl:			Results for Aq. H_2SO_4 :		
At 25°.			At 90°.		
Per cent HCl.	Gm. SiO_2 per 50 cc. Sol.	Per cent HCl.	Gm. SiO_2 per 50 cc. Sol.	Per cent H_2SO_4 .	Gm. SiO_2 per 50 cc. Sol.
0	0.0080	0	0.0213	3.9	0.0211
3	0.00665	2	0.0198	7.3	0.0186
6.3	0.00465	3	0.0186	15.6	0.0112
11.1	0.00245	5.4	0.0152	25.4	0.0058
18.9	0.0008	7.6	0.0115	36	0.0034
25.1	0.0006	10	0.0091	46.9	0.0013
34.6	0.0003	13.6	0.0056	55.6	0.0005
		18.6	0.0029	71	0.0004

At 90°, a slow current of CO_2 through the solutions did not affect the results. Ignited silica reaches equilibrium very slowly as compared with silica gel. The true solubility of ignited silica is probably the same as that of gelatinous silica.

SOLUBILITY OF SILICA IN MELTED CALCIUM CHLORIDE.
(Arndt and Lowenstein, 1909.)

t°.	Gms. SiO_2 per 100 Gms. Sat. Solution.
800	2.5
850	3.8
900	5.4

SILICA HYDRATE $3\text{SiO}_2 \cdot \text{H}_2\text{O}$.

SOLUBILITY OF SILICA HYDRATE IN 3.0 NORMAL AMMONIA AT 18°.
(Schwarz, 1916.)

The hydrate was prepared by conducting silicon fluoride into water. It was washed with water and dried at 150°. It contained 9.04 % H_2O . About 0.12 gm. quantities were shaken with 25 cc. portions of 3.0 *n* ammonia and allowed to stand. The amount dissolved per 25 cc. increased with the time of shaking from 0.0144 gm. after 4 hours to 0.0522 gm. after 228 hours. The curve drawn from the results showed that the maximum solubility was reached in about 200 hours. The solubility varies with the water content and modification of the silica. No ammonium silicate was formed.

SILICO TUNGSTIC ACID $\text{H}_2\text{SiW}_{12}\text{O}_{42}$.

100 gms. H_2O dissolve 961.5 crystallized silico tungstic acid at 18°, and the solution has Sp. Gr. 2.843.

TIN Sn

SOLUBILITY OF TIN IN RAW MILK.

(Quam, 1929.)

Highly polished 4 x 7.5 cm. strips of tin were each immersed in 50 cc portions of raw milk and rocked 46 times per minute for 30 minutes. The loss in weight of the Sn strips was determined and the results expressed as Mgs. Sn dissolved per sq. decimeter of surface exposed.

t°	Mg Sn dissolved per sq. dm. of surface
20-80	None
85	0.378
95	0.516

STANNOUS BROMIDE SnBr_2 .

Br

Fusion-point data are given for $\text{SnBr}_2 + \text{SnI}_2$ by Karantissis, 1927.

TIN Tetra BROMIDE SnBr_4 .

SOLUBILITY OF TIN TETRA BROMIDE IN LIQUID SULFUR DIOXIDE.
(Bond and Beach, 1926.)

The synthetic method was used and a special procedure was devised to prevent contact with moisture.

t°.	Per cent SnBr_4 .	Solid Phase.	t°.	Per cent SnBr_4 .	Solid Phase.
29.45.....	100.00	SnBr_4	39.75.....	40.63	liquid layers
24.90.....	98.74	"	25.00.....	26.09	"
21.15.....	97.30	"	*18.42.....	21.67	"
18.80.....	96.24	"	16.3 Quad. pt.	21.67	" + SO_2
18.00.....	95.62	"	*16.6.....	20.39	"
16.60.....	94.12	"	*8.0, 13.2.....	16.55	" + SO_2
16.55 Quad. pt.	94.07	" + liquid layer	*1.8, 10.7.....	14.08	" "
18.33.....	93.67	liquid layer	*—17.8, 7.1.....	11.88	" "
23.60.....	92.75	"	5.45.....	10.61	SO_2
28.70.....	91.65	"	3.25.....	9.45	"
34.25.....	89.81	"	2.5.....	8.93	"
42.60.....	85.54	"	— 3.5.....	6.29	"
45.75.....	82.49	"	— 5.0.....	5.37	"
47.25.....	80.31	"	—17.1.....	2.97	"
47.70.....	78.97	"	—21.8.....	2.41	"
48.60.....	75.14	"	—24.0.....	1.88	"
48.6 crit. t....	71.38	"	—37.7.....	0.92	"
48.50.....	64.00	"	—45.7.....	0.58	"
46.30.....	52.83	"	—53.05.....	0.39	"
41.67.....	43.60	"			

* Unstable points.

Fusion-point data are given for $\text{SnBr}_4 + \text{SnCl}_4$ by Raeder, 1927.

STANNOUS Nitroso β Phenyl HYDROXYLAMINE $\text{Sn}[\text{C}_6\text{H}_5\cdot\text{N}(\text{NO})\cdot\text{O}]_2$.

STANNIC " " $\text{Sn}[\text{C}_6\text{H}_5\cdot\text{N}(\text{NO})\cdot\text{O}]_4$.

One liter H_2O dissolve 0.000035 gm. atom of the SnII compound (= 0.0042 gm.) at 18° .

One liter H_2O dissolve 0.000021 gm. atom of the Sn IV compound (= 0.0024 gm.) at 18° . (Pinkus and Martin, 1927.)

TIN TetraPHENYL (Stannic) $\text{Sn}(\text{C}_6\text{H}_5)_4$.

Freezing-point data for $\text{Sn}(\text{C}_6\text{H}_5)_4 + \text{Si}(\text{C}_6\text{H}_5)_4$ are given by Pascal (1912).

TIN OXALATE (Stannous) $\text{Sn}(\text{COO})_2$.

100 gms. 95 per cent formic acid dissolve 0.16 gm. $\text{Sn}(\text{COO})_2$ at 19° . (Aschan, 1913.)

C1 **TIN CHLORIDE** (Stannous) SnCl_2 .

100 gms. H_2O dissolve 83.9 gms. SnCl_2 at 0° and 269.8 gms. at 15° . Sp. Gr. of Solutions 1.532 and 1.827 respectively. (Engel, 1889; Michel and Krafft, 1851.)

SOLUBILITY OF STANNOUS CHLORIDE IN AQUEOUS SOLUTIONS OF HYDROCHLORIDE ACID AT 0° .

(Engel.)

Milligram Mols. per 10 cc. Solution.		Sp. Gr. of Solution.	Grams per 100 cc. Solution.	
HCl.	$\frac{1}{2}\text{SnCl}_2$		HCl.	SnCl_2
0	74.0	1.532	0.0	70.26
6.6	66.7	1.489	2.405	63.33
13.54	63.75	1.472	4.935	60.52
24.8	68.4	1.524	9.04	64.95
34.9	81.2	1.625	12.72	77.11
40.0	94.2	1.724	14.58	89.45
44.0	117.6	1.883	16.04	111.7
49.4	147.6	2.114	18.01	138.6
66.0	156.4	2.190	24.05	148.5
78.0	157.0	2.199	28.43	149.0

100 gms. acetone dissolve 55.6 gms. SnCl_2 at 18° . ($d_{18} = 1.6$.) (Naumann, 1904.)

100 gms. ether dissolve 11.4 gms. $\text{SnCl}_2 \cdot 2\text{H}_2\text{O}$ at 0° - 35.5° .

100 gms. ethyl acetate dissolve 31.2 gms. $\text{SnCl}_2 \cdot 2\text{H}_2\text{O}$ at -2° , 35.53 gms. at $+22^\circ$ and 73.44 gms. at 82° . (von Laszynski, 1894.)

100 gms. ethyl acetate dissolve 4.46 gms. SnCl_2 at 18° . d_{18} of the sat. solution = 0.9215. (Naumann, 1910.)

100 gms. 95 per cent formic acid dissolve 4.1 gms. SnCl_2 at 19° . (Aschan, 1913.)

Freezing-point data for mixtures of $\text{SnCl}_2 + \text{ZnCl}_2$ are given by Herrmann (1911). Results for $\text{SnCl}_2 + \text{SnI}_2$ are given by Karantissis, 1927.

TIN CHLORIDE (Stannic) SnCl_4 .

DISTRIBUTION OF STANNIC CHLORIDE BETWEEN WATER AND XYLENE.

(Smirnov, 1907.)

Very concentrated aqueous stannic chloride solutions were agitated with xylene at various temperatures and the amount of SnCl_4 , in terms of Cl, which entered the xylene layer was determined. The amount of Sn and Cl in the xylene was found to correspond to SnCl_4 .

Results for Xylene + $\text{SnCl}_4 \cdot 5\text{H}_2\text{O}$.

t°.	Gms. Cl per 100 Gms.		$\frac{c}{c'}$.
	Aq. Layer, c.	Xylene Layer, c'.	
66	40.35	0.08	504.4
80	39.95	0.18	228.5
97.5	40.24	0.33	122.1
III	40.27	0.68	59.3

Per cent Cl in $\text{SnCl}_4 \cdot 5\text{H}_2\text{O}$ = 40.38.Results for Xylene + $\text{SnCl}_4 \cdot 4\text{H}_2\text{O}$.

t°.	Gms. Cl per 100 Gms.		$\frac{c}{c'}$.
	Aq. Layer, c.	Xylene Layer, c'.	
66	41.9	0.92	45.3
80	41.91	1.56	27
100	41.85	2.52	16.7
III	41.68	3.23	12.9

Per cent Cl in $\text{SnCl}_4 \cdot 4\text{H}_2\text{O}$ = 42.37.Results for Xylene + $\text{SnCl}_4 \cdot 3\text{H}_2\text{O}$.

t°.	Gms. Cl per 100 Gms.		$\frac{c}{c'}$.
	Aq. Layer, c.	Xylene Layer, c'.	
80	43.2	9.93	4.4
94	42.54	9.32	4.6
100	42.64	10.56	4.1
III	42.31	10.03	4.2

Per cent Cl in $\text{SnCl}_4 \cdot 3\text{H}_2\text{O}$ = 45.12.

DISTRIBUTION OF TIN BETWEEN AQUEOUS HYDROCHLORIC ACID AND ETHER AT ROOM TEMPERATURE. (Mylus, 1911.)

When 1 gm. of tin as the chloride, SnCl_4 , is dissolved in 100 cc. of aqueous hydrochloric acid and shaken with 100 cc. of ether, the following per cents of the metal enter the ethereal layers. With 20% HCl, 17 per cent; with 15% HCl, 28 per cent; with 10% HCl, 23 per cent; with 5% HCl, 10 per cent and with 1% HCl, 0.8 per cent of the tin.

Additional data for the distribution of SnCl_4 between water and Ethyl Ether at 18° are given by Smyth, 1928.

Data in the form of a diagram for the system $\text{SnCl}_4 + \text{HCl}$ are given by Chretien and Varger, 1935.

Cl

TIN Tetra CHLORIDE SnCl_4 .

SOLUBILITY OF TIN TETRA CHLORIDE IN LIQUID SULFUR DIOXIDE.

(Bond and Beach, 1926).

t° of m. pt.	t° of solubility.*	Per cent SnCl_4 .	t° of m. pt.	t° of solubility.	Per cent SnCl_4 .
-32.7		100.00	-43.8	-45.0	67.47
-38.7		95.23	-43.8	-45.0	66.06
-40.6		92.66	-43.9	-45.1	61.54
-42.6	-52.0	86.16	-44.0	-45.3	58.54
-43.25	-46.8	82.41	-44.1	-45.9	55.24
-43.6	-45.7	79.43	-44.3	-46.3	50.76
-43.6	-45.7	79.05	-44.8	-48.8	44.27
-43.4	-45.6	76.07	-47.1	-57.5	31.96
-43.4	-45.4	75.76	-49.8		26.29
-43.6	-44.9	72.62	-63.0		11.78
-43.7	-44.9	71.75	-72.7		5.40

* The temperature of solubility is that at which metastable liquid layers separate.

100 gms. sat. solution of tin tetra chloride in selenium oxychloride (SeOCl_2) contain 13.74 gms. SnCl_4 at 25°.
(Wise, 1923.)

Fusion-point data are given for:

SnCl	+ SnI_2	(Raeder, 1927.)
"	+ TiCl_4	(Nasu, 1933.)
"	+ Formic Acid Ethyl Ester	(1)(2)(3)
"	+ " " Methyl "	(1)(2)
"	+ Benzoic Acid Ethyl Ester	(1)(3)(4)

(1) Kurnakow, 1916; (2) Kurnakow and Kanov, 1924; (3) Kurnakow, Perelmutter and Kanov, 1915; (4) Kurnakow and Perelmutter, 1924.

Methyl, Ethyl, etc. TIN FLUORIDES.

F SOLUBILITY OF EACH SEPARATELY IN SEVERAL SOLVENTS. (Krause, 1918.)

Compound.	Formula.	t°.	Gms. compound per 100 gms.			
			CH_3OH .	$\text{C}_2\text{H}_5\text{OH}$.	H_2O .	C_6H_6 .
Trimethyl Tin Fluoride	$(\text{CH}_3)_3\text{SnF}$	31.3	2.45	1.08	0.846	0.005
Triethyl " "	$(\text{C}_2\text{H}_5)_3\text{SnF}$	32.3	4.39	2.20	0.182	0.034
Tri n propyl " "	$(n\text{C}_3\text{H}_7)_3\text{SnF}$	31.3	4.26	2.73	0.020	0.118
Tri isobutyl " "	$(i\text{C}_4\text{H}_9)_3\text{SnF}$	31.6	0.614	0.414	0.012	0.100
Tri isoamyl " "	$(i\text{C}_5\text{H}_{11})_3\text{SnF}$	31.3	1.22	1.03	0.003	0.967
Diethyl n propyl " "	$(\text{C}_2\text{H}_5)_2(n\text{C}_3\text{H}_7)\text{SnF}$	31.0	6.93	3.78	0.12	0.005
Dimethyl Tin Difluoride	$(\text{CH}_3)_2\text{SnF}_2$	30.7	0.33	0.081	4.66	—
Diethyl " "	$(\text{C}_2\text{H}_5)_2\text{SnF}_2$	30.8	2.64	0.45	2.03	0.047
Di n propyl " "	$(n\text{C}_3\text{H}_7)_2\text{SnF}_2$	32.0	1.91	0.93	0.22	—

TIN IODIDE (Stannous) SnI_2 .

SOLUBILITY IN WATER AND IN AQUEOUS HYDRIODIC ACID.

(Young, 1897.)

I

t°.	Gms. SnI_2 per 100 Gms. Aqueous HI Solutions of:							
	0% = H_2O .	5.83%.	9.60%.	15.2%.	20.44%.	24.8%.	30.4%.	36.82%.
20	0.98	0.20	0.23	0.60	1.81	4.20	10.86	25.31
30	1.16	0.23	0.23	0.64	1.81	4.06	10.28	23.46
40	1.40	0.33	0.28	0.71	1.90	4.12	10.06	23.15
50	1.69	0.46	0.38	0.82	2.12	4.34	10.35	23.76
60	2.07	0.66	0.55	1.11	2.51	4.78	11.03	24.64
70	2.48	0.91	0.80	1.37	2.92	5.43	11.97	25.72
80	2.95	1.23	1.13	1.83	3.70	6.38	13.30	27.23
90	3.46	1.65	1.52	2.40	4.58	7.82	15.52	29.84
100	4.03	2.23	2.04	3.63	5.82	9.60	...	34.05

TIN IODIDE (Stannic) SnI_4 .

SOLUBILITY IN ORGANIC SOLVENTS.

(McDermott, 1911.)

Solvent.	t°.	Sp. Gr. Sat. Sol.	Gms. SnI_4 per 100 Gms. Sat. Sol.
Carbon Tetrachloride	22.4	1.59	5.25
"	50	1.63	12.50
Chloroform	28	1.50	8.21
Benzene	20.2	0.95	12.65

SOLUBILITY OF STANNIC IODIDE IN CARBON DISULFIDE.

(Sneider, 1866; Arctowski, 1895-'96.)

-114°.5. -94°. -89°. -84°. -58°. Ord. temp.

Gms. SnI_4 per 100 Gms.

Solution

9.41 10.65 9.68 10.22 16.27 59.2(S)

100 gms. methylene iodide, CH_2I_2 , dissolve 22.9 gms. SnI_4 at 10°. Sp. Gr. of solution = 3.481. (Retgers, 1893.)

SOLUBILITY OF STANNIC IODIDE IN SEVERAL SOLVENTS.

(Dorman and Hildebrand, 1927.)

Solvent	Gms. SnI_4 per 100 gms. sat. solution at:			Solvent	Gms. SnI_4 per 100 gms. sat. solution at:		
	10°	25°	40°		10°	25°	40°
Heptane	2.02	3.36	5.24	Toluene	9.99	14.89	21.93
Ethyl Ether	3.64	4.80	6.36	m Xylene	8.62	13.42	20.00
CCl_4	3.56	5.69	9.04	Ethylene bromide	9.11	14.16	20.91
Chloroform	4.94	8.28	12.91	CS_2	49.01	58.53	67.56
Benzene	9.76	15.17	23.02	Sulfur	(76.2)	(90.8)	—
					(104°)	(130°)	

SOLUBILITY OF STANNIC IODIDE IN SEVERAL LIQUID PARAFFINS.

(Dice and Hildebrand, 1928.)

Results for:

n Octane		n Heptane		n Hexane		iso Octane	
t°	Mol. fraction SnI_4 in sat. sol.	t°	Mol. fraction SnI_4 in sat. sol.	t°	Mol. fraction SnI_4 in sat. sol.	t°	Mol. fraction SnI_4 in sat. sol.
127.3	0.3602	127.6	0.2836	138.1	0.2531	183.4	0.3029
129.4	0.3824	130.9	0.3220	143.4	0.2887	191.6	0.3692
131.1	0.4454	134.8	0.3720	146.4	0.3225	194.9	0.4592
131.2	0.4541	136.4	0.4340	148.8	0.3714	195.3	0.50
132.0	0.52	136.8	0.48	149.4	0.42	195.4	0.5193
132.3	0.5418	136.7	0.4861	148.7	0.4526	194.9	0.5380
131.5	0.5832	135.4	0.5606	145.4	0.5344	193.6	0.5920
130.2	0.6297	131.5	0.6105	138.2	0.5916	181.5	0.6922
129.4	0.6430	127.2	0.6818				

* = Critical solution temperature; iso Octane = 2.2.4 Tri methyl pentane.

SOLUBILITY OF STANNIC IODIDE IN SILICON TETRA CHLORIDE.

(Hildebrand and Negishi, 1937.)

t°	Mol. fraction SnI_4 in sat. sol.	t°	Mol. fraction SnI_4 in sat. sol.
0.2	0.155	Solid 139.4	32.53
25.0	0.381	" 139.8	37.62
40.0	0.639	" 139.9	39.00
81.3	2.36	" 139.7	43.16
112.1	6.43	" 139.5	43.54
115.6	7.40	" 139.1	45.06
131.0	65.36	" 138.8	46.95
130.9	21.56	Liquid 135.7	51.21
133.4	24.21	" 135.8	51.62
138.2	29.58	" 132.4	55.12
			Liquid

* Critical solution temperature.

Fusion-point data for the system $\text{SnI}(\text{CH}_3)_3 + \text{C}_6\text{H}_5\text{NH}_2$ are given by

Sn STANNUM

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TIN HYDROXIDE (Stannous) $\text{Sn}(\text{OH})_2$.

One liter of the saturated solution in water contains 0.0000135 gm. mols. $\text{Sn}(\text{OH})_2$ at 25° . (Goldschmidt and Eckhardt, 1906.)

SOLUBILITY OF STANNOUS HYDROXIDE IN AQUEOUS SODIUM HYDROXIDE SOLUTIONS AT 25° .

(Goldschmidt and Eckhardt, 1906.)

The authors desired to ascertain whether the mono, NaHSnO_2 , or the disodium salt, Na_2SnO_2 , predominates in alkaline tin hydroxide solutions. Given amounts of carefully prepared tin chloride, made from tin and HCl , and sodium hydroxide solutions were mixed in vessels containing hydrogen. The mixtures were shaken at 25° and the clear supernatant solutions in contact with the precipitated $\text{Sn}(\text{OH})_2$, analyzed.

OH

Gm. Mols. per Liter.			Gm. Mols. per Liter.		
Total Na.	NaHSnO_2 .	NaOH .	Total Na.	NaHSnO_2 .	NaOH .
0.00451	0.0000845	0.003525	0.02250	0.00838	0.01412
0.00680	0.00218	0.00462	0.02788	0.01038	0.01755
0.01149	0.003495	0.007995	0.02940	0.00874	0.02066
0.02143	0.006935	0.014495	0.03012	0.00865	0.02147
0.02143	0.00660	0.01483	0.03036	0.01082	0.01954
0.02186	0.00628	0.015575	0.03044	0.009405	0.021035

SOLUBILITY IN AQUEOUS SODIUM HYDROXIDE SOLUTIONS. MOIST TIN HYDROXIDE USED. ORDINARY TEMPERATURE.

(Rubenbauer, 1902.)

Gms. per 20 cc. Solution.		Mol. Dilution of the NaOH .	Gms. per 20 cc. Solution.		Mol. Dilution of the NaOH .
Na.	Sn.		Na.	Sn.	
0.2480	0.1904	1.86	0.8326	0.5560	0.55
0.3680	0.2614	1.25	0.9661	0.7849	0.48
0.6394	0.4304	0.72	2.1234	1.8934	0.23

STANNIC SULFIDE SnS_2 .

SOLUBILITY OF STANNIC SULFIDE IN AQUEOUS SOLUTIONS OF AMMONIA.

(Epik, 1932.)

S

The determinations were made by boiling mixtures of sulfide and aqueous ammonia of various concentrations for 5 minutes over a Bunsen burner. The solutions thus obtained were analyzed for tin and the residual ammonia.

Percent concentration of NH_3 in solvent		Gms. SnS_2 dissolved per 100cc sat. sol.
at beginning	at end	
1.0	0.8	0.13
3.0	2.3	0.33
6.0	3.8	0.49
12.0	7.0	0.85
25.0	12.0	1.26

The effect of variation in time of heating and of the ratio of sulfide to ammonia was also studied.

TIN SULFATE (Stannous) SnSO_4 .

100 gms. H_2O dissolve 18.8 gms. SnSO_4 at 19° and 18.1 gms. at 100° . (Marignac.)

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EQUILIBRIUM IN THE SYSTEM STANNOUS OXIDE, SULFUR TRIOXIDE AND WATER.
(Denham and King, 1935.)

Results at 25°

Results at 50°

d. of sat. sol.	Gms. per 100 SnO	gms. sat. sol. SO ₃	Solid Phase	d. of sat. sol.	Gms. per 100 SnO	gms. sat. sol. SO ₃	Solid Phase
1.004	0.30	0.20	1.2.4	1.018	1.04	0.68	1.2.2
1.030	2.21	1.36	"	1.037	2.53	1.53	" + 1.1
1.040	3.07	1.87	"	1.058	3.80	2.17	1.1
1.065	4.56	2.76	"	1.145	9.33	5.64	"
1.090	6.30	3.72	" + 1.1	1.230	14.00	8.30	"
1.120	8.02	4.85	1.1	1.245	14.81	8.74	" + SnSO ₄
1.185	11.68	6.79	"	1.220	8.74	14.12	SnSO ₄
1.250	15.15	8.87	"	1.263	7.42	19.66	"
1.270	16.30	9.50	"	1.326	5.06	28.43	"
1.300	17.56	10.27	" + SnSO ₄				
1.365	14.64	10.52	SnSO ₄				
1.240	11.83	10.64	"				
1.220	9.43	12.85	"				
1.210	6.39	15.92	"				
1.239	2.98	23.00	"				
1.307	1.50	31.30	"	1.2.4 =	SnSO ₄ . 2SnO . 4H ₂ O		
1.404	0.60	40.90	"	1.2.2 =	SnSO ₄ . 2SnO . 2H ₂ O		
1.508	0.36	49.63	"	1.1 =	SnSO ₄ . SnO		

SO

STRONTIUM ARSENATES SrHAsO₄, and Sr(H₂AsO₄)₂.EQUILIBRIUM IN THE SYSTEM STRONTIUM OXIDE, ARSENIC
PENTOXIDE AND WATER AT 25°.
(Tartar, Rice and Sweo, 1931.)

d. of sat. sol.	Gms. per 100 As ₂ O ₅	gms. sat. sol. SrO	Solid Phase	d. of sat. sol.	Gms. per 100 As ₂ O ₅	gms. sat. sol. SrO	Solid Phase
1.001	0.18	0.14	SrHAsO ₄	1.489	33.59	5.98	Sr(H ₂ AsO ₄) ₂
1.010	1.01	0.48	"	1.542	37.59	5.60	"
1.042	3.33	1.56	"	1.555	39.71	5.01	"
1.080	5.41	2.43	"	1.605	42.94	4.44	"
1.126	8.33	3.84	"	1.805	55.20	2.23	"
1.199	12.29	5.72	"	1.851	57.97	1.32	"
1.273	17.31	7.30	" + Sr(H ₂ AsO ₄) ₂	1.999	64.75	0.43	"
1.339	23.38	6.81	Sr(H ₂ AsO ₄) ₂	2.236	71.71	0.09	"
1.362	26.08	6.24	"				

Sr STRONTIUM

1496

STRONTIUM CACODYLATE $\text{Sr}[(\text{CH}_3)_2\text{AsO}_2]_2 \cdot 13\text{H}_2\text{O}$.

SOLUBILITY OF STRONTIUM CACODYLATE IN WATER. (Tollals, 1936.)

t°	Gms. $\text{Sr}[(\text{CH}_3)_2\text{AsO}_2]_2$ per 100 gms. sat. sol.	Solid Phase	t°	Gms. $\text{Sr}[(\text{CH}_3)_2\text{AsO}_2]_2$ per 100 gms. sat. sol.	Solid Phase
0	44.11	$\text{Sr}[(\text{CH}_3)_2\text{AsO}_2]_2 \cdot 13\text{H}_2\text{O}$	52	67.94	$\text{Sr}[(\text{CH}_3)_2\text{AsO}_2]_2 \cdot 13\text{H}_2\text{O}$
8.5	46.71	"	57	68.42	$\text{Sr}[(\text{CH}_3)_2\text{AsO}_2]_2 \cdot 13\text{H}_2\text{O}$
17.0	50.34	"	60	69.01	"
19	52.60	"	62	69.25	"
22.5	54.90	"	67	69.50	"
27.0 m.pt.	60.70	"	72.5	69.97	"
31	62.01	$\text{Sr}[(\text{CH}_3)_2\text{AsO}_2]_2 \cdot 13\text{H}_2\text{O}$	79	70.75	"
35	62.92	"	83	71.50	"
40.5	65.05	"	84	72.50	"
45	66.25	"	94	73.14	"
50	67.52	"	99	74.34	"

SOLUBILITY OF STRONTIUM CACODYLATE IN ALCOHOLS. (Tollals, 1936.)

Solvent	t°	Gms. $\text{Sr}[(\text{CH}_3)_2\text{AsO}_2]_2$ per 100 gms. sat. sol.	Solid Phase
Methyl Alcohol	12	56.08	$\text{Sr}[(\text{CH}_3)_2\text{AsO}_2]_2 \cdot 7\text{H}_2\text{O}$
Ethyl Alcohol (95%)	15	38.40	"
Ethyl Alcohol (abs.)	15	38.60	"

Br

STRONTIUM BROMIDE $\text{SrBr}_2 \cdot 6\text{H}_2\text{O}$.

SOLUBILITY IN WATER.

(Average curve from results of Kremers, 1858; and Etard, 1894.)

t°	Gms. SrBr_2 per 100 Gms.		t°	Gms. SrBr_2 per 100 Gms.	
	Solution.	Water.		Solution.	Water.
0	46	85.2	40	55.2	123.2
10	48.3	93	50	57.6	135.8
20	50.6	102.4	60	60	150
25	51.7	107	80	64.5	181.8
30	52.8	111.9	100	69	222.5

Sp. Gr. of sat. solution at 20° approximately 1.70.
100 gms. abs. alcohol dissolve 64.5 gms. SrBr_2 at 0° .

Sp. Gr. of solution = 1.21.
(Fonzes-Diacon, 1895.)

SOLUBILITY OF STRONTIUM BROMIDE IN AQUEOUS SOLUTIONS OF HYDROBROMIC ACID AT 25° . (Scott and Durham, 1930.)

Gms. per 100 gms. sat. sol.		Solid Phase
HBr	SrBr_2	
0.0	49.93	$\text{SrBr}_2 \cdot 6\text{H}_2\text{O}$
3.77	45.18	"
9.39	38.21	"
17.50	28.36	"

STRONTIUM BROMIDE $\text{SrBr}_2 \cdot 6\text{H}_2\text{O}$.

FREEZING-POINTS OF AQUEOUS SOLUTIONS OF STRONTIUM BROMIDE. (Milikan, 1917.)

t°.	Gms. SrBr_2 per 100 gms. sat. sol.	Solid Phase.	t°.	Gms. SrBr_2 per 100 gms. sat. sol.	Solid Phase.
-1.7.....	6.9	Ice	-19.0.....	34.8	Ice
-4.2.....	13.9	"	-28.0 (eutec.).	41.7	" + $\text{SrBr}_2 \cdot 6\text{H}_2\text{O}$
-8.4.....	23.2	"	0.....	46.8 (Kremers)	$\text{SrBr}_2 \cdot 6\text{H}_2\text{O}$
-13.5.....	29.8	"			

SOLUBILITY OF STRONTIUM BROMIDE IN AQUEOUS**SOLUTIONS OF STRONTIUM OXIDE AT 25° AND VICE VERSA.** (Millikan, 1917.)

Gms. per 100 gms. sat. sol.		Solid Phase.	Gms. per 100 gms. sat. sol.		Solid Phase.
SrBr_2	SrO		SrBr_2	SrO	
49.79	0.0	$\text{SrBr}_2 \cdot 6\text{H}_2\text{O}$	40.66	0.84	$\text{SrBr}_2 \cdot \text{SrO} \cdot 9\text{H}_2\text{O} + \text{SrO} \cdot 9\text{H}_2\text{O}$
49.78	0.21	" + $\text{SrBr}_2 \cdot \text{SrO} \cdot 9\text{H}_2\text{O}$	38.68	0.79	$\text{SrO} \cdot 9\text{H}_2\text{O}$
48.06	0.25	$\text{SrBr}_2 \cdot \text{SrO} \cdot 9\text{H}_2\text{O}$	35.83	0.73	"
47.65	0.28	"	27.33	0.66	"
44.24	0.47	"	21.46	0.65	"
42.76	0.61	"	16.27	0.66	"
41.78	0.64	"	0.0	0.85	"

SOLUBILITY OF STRONTIUM BROMIDE IN AQUEOUS SOLUTIONS OF STRONTIUM NITRATE AT 25°.

(Harkins and Pearce, 1916.)

Mols. per 1000 Gms. H_2O .	Gms. SrBr_2 per 1000 Gms. H_2O .	d_{25} of Sat. Sol.	Mols. per 1000 Gms. H_2O .	Gms. SrBr_2 per 1000 Gms. H_2O .	d_{25} of Sat. Sol.
$\text{Sr}(\text{NO}_3)_2$	SrBr_2		$\text{Sr}(\text{NO}_3)_2$	SrBr_2	
0	4.3080	1066.1	0.30663	4.3180	1068.8
0.036	4.3105	1066.95	0.61124	4.3190	1069.17
0.07216	4.3125	1067.42	1.8610	4.3390	1073.97
0.14568	4.3170	1068.54			

Br

Data for equilibrium in the system strontium bromide, strontium oxide and water at 25° are given by Milikan (1916).

STRONTIUM BROMIDE $\text{SrBr}_2 \cdot 6\text{H}_2\text{O}$.

The composition of the homogeneous mixture (Plait Point) of the system composed of Strontium Bromide, tertiary Butyl Alcohol and Water at 25° was found by Ginnings, Herring and Webb, 1933, to be

20.4 gms. SrBr_2 + 29.8 gms. ter. $(\text{CH}_3)_3\text{COH}$ + 49.8 gms. H_2O .

The original results for the remaining points on the binodal curve are not given but only the values of a series of constants calculated by means of empirical equations.

EQUILIBRIUM IN THE SYSTEM STRONTIUM BROMIDE, UREA AND WATER AT 11°.

(de Carli, 1932.)

Gms. per 100 gms. sat. sol.	Solid Phase	Gms. per 100 gms. sat. sol.	Solid Phase
SrBr_2	$\text{CO}(\text{NH}_2)_2$	SrBr_2	$\text{CO}(\text{NH}_2)_2$
47.20	0.0	35.23	29.90
47.20	3.71	28.20	36.50
46.50	15.20	25.78	40.12
46.18	19.50	21.50	40.45
42.52	22.56	14.27	40.90
		—	40.84

$$1.4.2 = \text{SrBr}_2 \cdot 4\text{CO}(\text{NH}_2)_2 \cdot 2\text{H}_2\text{O}.$$

Sr STRONTIUM

1498

SOLUBILITY OF STRONTIUM BROMIDE IN PURE METHYL ALCOHOL AND IN PURE ETHYL ALCOHOL.

(Lloyd, Brown, Glynwyn, Bonnel and Jones, 1928.)

Results for Methyl Alcohol

t°	Gms. SrBr ₂ per 100 gms. CH ₃ OH.	Solid Phase
10	115.0	SrBr ₂ · 1½CH ₃ OH
20	119.4	"
30	123.4	"
40	125.5	"
50	129.6	SrBr ₂ · ½CH ₃ OH
60	136.1	"
70	144.6	"

Results for Ethyl Alcohol

t°	Gms. SrBr ₂ per 100 gms. C ₂ H ₅ OH	Solid Phase
10	63.6	SrBr ₂ · ½C ₂ H ₅ OH
20	63.9	"
30	64.9	"
40	73.5	"
50	75.2	SrBr ₂
60	75.5	"
80	75.8	"

100 cc Iso Amyl Alcohol (d=0.805) dissolve 30.5 gms. SrBr₂ at 25°. (Yagoda, 1930.)

STRONTIUM BROMIDE

SOLUBILITY OF STRONTIUM BROMIDE IN ABSOLUTE ACETONE.

(Bell, Rowlands, Benford, Thomas and Jones, 1930.)

t°	Gms. SrBr ₂ per 100 gms. (CH ₃) ₂ CO	Solid Phase	t°	Gms. SrBr ₂ per 100 gms. (CH ₃) ₂ CO	Solid Phase
0	0.869	SrBr ₂ · 1½C ₃ H ₈ O	28.5	0.429	SrBr ₂ · 1½C ₃ H ₈ O
10	0.753	"	35	0.359	SrBr ₂ · C ₃ H ₈ O
20	0.599	"	40	0.323	"
27	0.454	"	50	0.274	"

100 gms. liquid Ammonia (NH₃) dissolve 0.008 gm. SrBr₂ at 0°. (Linhard and Stephens, 1934.)

STRONTIUM BROMATE Sr(BrO₃)₂.

One liter of aqueous solution contains 0.9 gm. molecules or 309 gms. Sr(BrO₃)₂ at 18°. (Kohlrausch, 1897.)

STRONTIUM METHIONATE SrCH₂O₆S₂.

100 gms. H₂O dissolve 2.14 gm. SrCH₂O₆S₂ at 25°. (Backer and Terpstra, 1929.)

STRONTIUM FORMATE Sr(HCOO)₂ · 2H₂O.

SOLUBILITY IN WATER. (Stanley, 1904.)

t°	Gms. Sr(HCOO) ₂ per 100 Gms. H ₂ O.	Solid Phase.	t°	Gms. Sr(HCOO) ₂ per 100 Gms. H ₂ O.	Solid Phase.
0	7.02 (8.35)	Sr(HCOO) ₂ · 2H ₂ O	67.5	20.62 (21.76)	Sr(HCOO) ₂ · 2H ₂ O
11	8.08 (9.54)	"	81.5	26.14 (26.36)	"
28.6	11.62 (13.25)	"	86	27.58 (27.57)	Sr(HCOO) ₂ · H ₂ O
37.4	13.01 (14.68)	"	91.7	27.01 (27.07)	"
51.4	16.31 (17.83)	"	100	26.57 (26.72)	"

There appears to be an error in the calculation of the results as given by the author in his table. The figures given above in parentheses have, therefore, been calculated from the weights of SrSO₄ recorded in the original table and show the weight of Sr(HCOO)₂ per 100 gms. of saturated solution.

Br

CH

Later very careful determinations of the solubility of Strontium Formate in Water by Ashton, Houston and Saylor, 1933, are as follows.

t°	Gms. Sr(HCOO) ₂ per 100 gms. H ₂ O	Solid	t°	Gms. Sr(HCOO) ₂ per 100 gms. H ₂ O	Solid Phase
0	9.1	Sr(HCOO) ₂ ·2H ₂ O	60	25.0	Sr(HCOO) ₂ ·2H ₂ O
10	10.6	"	70	30.0	"
20	12.7	"	72	31.2	"
30	15.2	"	80	31.9	Sr(HCOO) ₂
40	17.8	"	90	32.9	"
50	21.0	"	100	34.4	"

EQUILIBRIUM IN THE SYSTEM STRONTIUM FORMATE, FORMIC ACID & WATER AT 25°.
(Dunn and Philip, 1934.)

Gms. per 100 gms. sat. sol.	Solid	Gms. per 100 gms. sat. sol.	Solid
HCOOH	Phase	HCOOH	Phase
0.0	12.52 Sr(HCOO) ₂ ·2H ₂ O	61.5	20.51 Sr(HCOO) ₂
18.01	13.30 "	63.3	20.74 "
34.24	14.17 "	64.7	20.94 "
41.5	15.28 "	68.7	21.3 "+2Sr(HCOO) ₂ ·HCOOH
48.0	16.40 "	70.5	22.04 2Sr(HCOO) ₂ ·HCOOH
53.4	18.27 "	72.3	22.54 "
57.3	20.07 "	74.3	23.07 "

STRONTIUM ACETATE Sr(CH₃COO)₂·½H₂O.

SOLUBILITY IN WATER.
(Osaka and Abe, 1911.)

CH

t°	Gms. Sr(CH ₃ COO) ₂ per 100 Gms. H ₂ O.	Solid Phase.	t°	Gms. Sr(CH ₃ COO) ₂ per 100 Gms. H ₂ O.	Solid Phase.
0.05	36.93	Sr(CH ₃ COO) ₂ ·4H ₂ O	25	40.19	Sr(CH ₃ COO) ₂ ·½H ₂ O
5	39.91	"	35.03	38.82	"
10	43.61	"	50	37.35	"
8.4 tr. pt.	43.1	" + Sr(CH ₃ COO) ₂ ·½H ₂ O	70	36.24	"
8	43.5	Sr(CH ₃ COO) ₂ ·½H ₂ O	80	36.10	"
10	42.95	"	90	36.24	"
15	41.90	"	97	36.36	"

EQUILIBRIUM IN THE SYSTEM STRONTIUM ACETATE, ACETIC ACID AND WATER AT 25°.
(Dunn and Philip, 1934.)

Gms. per 100 gms. sat. sol.	Solid	Gms. per 100 gms. sat. sol.	Solid
CH ₃ COOH	Phase	CH ₃ COOH	Phase
0.0	28.79 2Sr(CH ₃ COO) ₂ ·H ₂ O	50.4	15.21 5.5.9
2.75	28.20 "	57.3	15.25 1.2.2
11.62	22.09 "	65.2	14.32 "
22.63	18.27 5.5.9	71.9	14.42 "
33.10	16.49 "	76.1	16.90 "
41.6	15.56 "		

5.5.9 = 5Sr(CH₃COO)₂·5CH₃COOH·9H₂O; 1.2.2 = Sr(CH₃COO)₂·2CH₃COOH·2H₂O.

100 gms. pure Methyl Alcohol. sat. with anhydrous strontium acetate contain 0.26 gm. Sr(CH₃COO)₂ at 15° and 0.18 gm. at 66° (b.pt.).
(Henstock, 1934.)

Sr STRONTIUM

1500

SOLUBILITY OF STRONTIUM ACETATE IN ANHYDROUS ACETIC ACID.

(Davidson and Chappell, 1933.)

t°	Gm. Mol. Percent Sr(CH ₃ COO) ₂ in sat. sol.	Solid Phase	t°	Gm. Mol. Percent Sr(CH ₃ COO) ₂ in sat. sol.	Solid Phase
16.6	0.0	CH ₃ COOH	66.5	5.89	Sr(CH ₃ COO).CH ₃ COOH
15.5	2.08	"	77.5	6.52	"
14.5	4.31	"	86.0	7.12	"
13.69	5.73*	"	101.1	8.57	"
13.02	7.15*	"	108.8	9.52	"
17.0	4.76	Sr(CH ₃ COO) ₂ .CH ₃ COOH	111.5	9.95	"
29.7	4.85	"	118.5	10.45	Sr(CH ₃ COO) ₂ (?)
50.0	5.2	"	121.8	10.76	"

STRONTIUM TARTRATE SrC₄H₄O₆.3H₂O.

SOLUBILITY IN WATER.

(Cantoni and Zachoder, 1905.)

t°	Gms. SrC ₄ H ₄ O ₆ .3H ₂ O per 100 cc. Solution.	t°	Gms. SrC ₄ H ₄ O ₆ .3H ₂ O per 100 cc. Solution.	t°	Gms. SrC ₄ H ₄ O ₆ .3H ₂ O per 100 cc. Solution.
0	0.112	25	0.224	60	0.486
10	0.149	30	0.252	70	0.580
15	0.174	40	0.328	80	0.688
20	0.200	50	0.407	85	0.755

CH

SOLUBILITY OF STRONTIUM TARTRATE IN AQUEOUS SOLUTIONS OF ACETIC ACID AT 26°-27°.

(Herz and Muhs, 1903.)

Normality of Acetic Acid.	Gms. per 100 cc. Solution.	Normality of Acetic Acid.	Gms. per 100 cc. Solution.
	CH ₃ COOH.		SrC ₄ H ₄ O ₆ .3H ₂ O.
0	0	3.77	21.85
0.565	3.39	5.65	33.90
1.425	8.15	16.89	101.34
2.85	17.10		

STRONTIUM TARTRATE Active, C₄H₄O₆Sr.4 H₂O; Racemic, C₈H₈O₁₂Sr₂.8 H₂O.

SOLUBILITY OF ACTIVE AND OF RACEMIC STRONTIUM TARTRATE, EACH SEPARATELY, IN WATER. (Deboux and Cuitat, 1921.)

Saturation was secured by continuous agitation in a thermostat for 7 to 10 hours. The strontium was determined as carbonate and as sulfate.

Results for the Active salt.			Results for the Racemic salt.		
t°.	Gms. C ₄ H ₄ O ₆ Sr per 100 gms. sat. sol.	Solid Phase.	t°.	Gms. C ₈ H ₈ O ₁₂ Sr ₂ per 100 gms. sat. sol.	Solid Phase.
0.0....	0.0942	C ₄ H ₄ O ₆ Sr.4 H ₂ O	0.0....	0.0107	C ₈ H ₈ O ₁₂ Sr ₂ .8 H ₂ O
12.5....	0.1285	"	12.5....	0.0202	"
25.0....	0.1765	"	25.0....	0.0297	"
37.5....	0.2395	"	37.5....	0.0392	"

STRONTIUM MALATE $\text{SrC}_4\text{H}_4\text{O}_6$.**SOLUBILITY IN WATER.**

(Cantoni and Basadonna, 1906.)

t°.	Gms. per 100 cc. Solution.	t°.	Gms. per 100 cc. Solution.	t°.	Gms. per 100 cc. Solution.
20	0.448	40	1.385	55	2.460
25	0.550	45	1.743	60	2.821
30	0.752	50	2.098	65	3.148
35	1.036			70	3.360

STRONTIUM MALATE Active, $\text{C}_4\text{H}_4\text{O}_5\text{Sr} \cdot 4\text{H}_2\text{O}$; Racemic, $\text{C}_8\text{H}_8\text{O}_{10}\text{Sr}_2 \cdot 5\text{H}_2\text{O}$.**SOLUBILITY OF ACTIVE AND OF RACEMIC STRONTIUM MALATE,**

EACH SEPARATELY, IN WATER. (Duboux and Cattal, 1921.)

Saturation was secured by continuous rotation in a thermostat for 7 to 10 hours. The strontium was determined as carbonate and as sulfate.

Results for the Active Salt.

t°.	Gms. $\text{C}_4\text{H}_4\text{O}_5\text{Sr}$ per 100 gms. sat. sol.	Solid Phase.
0.0...	0.193	$\text{C}_4\text{H}_4\text{O}_5\text{Sr} \cdot 4\text{H}_2\text{O}$
12.5...	0.332	"
25.0...	0.490	"
37.5...	0.781	"

Results for the Racemic Salt.

t°.	Gms. $\text{C}_8\text{H}_8\text{O}_{10}\text{Sr}_2$ per 100 gms. sat. sol.	Solid Phase.
0.0...	0.290	$\text{C}_8\text{H}_8\text{O}_{10}\text{Sr}_2 \cdot 5\text{H}_2\text{O}$
12.5...	0.325	"
25.0...	0.422	"
37.5...	0.550	"

SOLUBILITY OF STRONTIUM MALATE IN AQUEOUS SOLUTIONS OF STRONTIUM CHLORIDE AT 23°. (Walker, 1925.)

Constant agitation in a thermostat was employed for obtaining saturation. The results are expressed in terms of gram molecules of the saturating salt per 1000 gms. H_2O « corresponding to the weight molar concentration of the added salt ».

Gram. mols. per 1000 gms. H_2O	
Sr. malate.	SrCl_2 .
0.03050	0.0000
0.02523	0.01828

Gram. mols. per 1000 gms. H_2O	
Sr. malate.	SrCl_2 .
0.02349	0.03103
0.02019	0.06149

CH

STRONTIUM MALONATE $\text{CH}_2(\text{COO})_2\text{Sr}$.**SOLUBILITY IN WATER.**

(Cantoni and Diotallevi, 1905.)

t°.	Gms. per 100 cc. Sat. Sol.	t°.	Gms. per 100 cc. Sat. Sol.	t°.	Gms. per 100 cc. Sat. Sol.
0	0.541	25	0.521	40	0.464
10	0.540	30	0.499	45	0.453
20	0.532	35	0.478	50	0.443

SOLUBILITY OF STRONTIUM MALONATE IN AQUEOUS SOLUTIONS OF STRONTIUM CHLORIDE AT 25°.

(Walker, 1925.)

Gms. per liter sat. sol.		Solid Phase
SrCl_2	$\text{SrCH}_2(\text{COO})_2$	
0.0	5.783	$\text{SrCH}_2(\text{COO})_2 (?)$
2.898	4.784	"
4.919	4.454	"
5.747	3.828	"

STRONTIUM FUMARATE $\text{SrC}_4\text{H}_2\text{O}_4$.100 gms. H_2O dissolve 0.29 gm. $\text{SrC}_4\text{H}_2\text{O}_4$ at 30°.

(Weiss and Downs, 1923.)

Sr STRONTIUM

1502

STRONTIUM SUCCINATE $C_4H_4O_4Sr$.

100 gms. sat. solution in water contain 0.439 gm. $C_4H_4O_4Sr$ at 15° and 0.215 gm. at 100°.

(Tarugi and Checchi, 1901.)

SOLUBILITY OF STRONTIUM SUCCINATE IN WATER.

(Cantoni and Diotallevi, 1905.)

t°.	Gms. $C_4H_4O_4Sr$ per 100 cc. Sat. Sol.	t°.	Gms. $C_4H_4O_4Sr$ per 100 cc. Sat. Sol.	t°.	Gms. $C_4H_4O_4Sr$ per 100 cc. Sat. Sol.
0	0.052	20	0.270	40	0.375
5	0.076	25	0.382	45	0.389
10	0.111	30	0.451	50	0.424
15	0.177	35	0.413		

SOLUBILITY OF STRONTIUM SUCCINATE IN AQUEOUS SOLUTIONS OF SODIUM SUCCINATE AT 25°. (Walker, 1925.)

Constant agitation in a thermostat was employed for obtaining saturation. The results are expressed in terms of gram molecules of the saturating salt per 1000 gms. H_2O « corresponding to the weight molar concentration of the added salt ».

Gm. mols. per 1000 gms. H_2O .		Gm. mols. per 1000 gms. H_2O .	
$C_4H_4O_4Sr$.	$C_4H_4O_4Na_2$.	$C_4H_4O_4Sr$.	$C_4H_4O_4Na_2$.
0.02013	0.0000	0.01322	0.03751
0.01740	0.00938	0.01221	0.05582
0.01535	0.01875	0.01143	0.07457

CH

STRONTIUM CITRATE $Sr(C_6H_5O_7)_2 \cdot 6H_2O$ and $Sr(C_6H_5O_7)_2 \cdot H_2O$.**SOLUBILITY OF EACH HYDRATE SEPARATELY, IN WATER.** (Chatterjee and Dhar, 1924.)

t°.	Gms. $Sr(C_6H_5O_7)_2$ per liter of Aq. solution sat. with	
	$Sr(C_6H_5O_7)_2 \cdot 6H_2O$.	$Sr(C_6H_5O_7)_2 \cdot H_2O$.
30.....	1.26	2.97
95.....	1.57	1.54

STRONTIUM PHENOLATE $(C_6H_5O)_2Sr \cdot 4H_2O$.**EQUILIBRIUM IN THE SYSTEM STRONTIUM HYDROXIDE, PHENOL AND WATER AT 25°.** (Van Meurs, 1916.)

Mols. per 100 mols. sat. sol.		Solid Phase.	Mols. per 100 mols. sat. sol.		Solid Phase.
$Sr(OH)_2$.	C_6H_5OH .		$Sr(OH)_2$.	C_6H_5OH .	
2			2		
0.30	0.0	$Sr(OH)_2 \cdot 8H_2O$	6.82	9.67	$(C_6H_5O)_2Sr \cdot 4H_2O$
0.72	0.49	»	8.87	20.24	»
1.48	1.28	»	9.38	24.84	»
3.83	3.74	»	11.16	47.30	»
4.86	4.80	»	9.62	63.77	» + C_6H_5OH
5.58	5.52	»	6.17	65.46	C_6H_5OH
6.12	6.04	» + $(C_6H_5O)_2Sr \cdot 11H_2O$	3.54	69.91	»

At concentrations of $Sr(OH)_2$ less than 0.5 mol. per cent two liquid layers are formed. Analyses of these gave the following results.

Aqueous layer.		Phenol layer.	
Mol. % $Sr(OH)_2$.	Mol. % C_6H_5OH .	Mol. % $Sr(OH)_2$.	Mol. % C_6H_5OH .
0.12	2.05	0.31	24.41
0.17	2.37	0.43	21.12
0.22	2.72	0.50	18.72
0.34	4.50	0.55	12.95

STRONTIUM BENZOATE $\text{Sr}(\text{C}_7\text{H}_5\text{O}_2)_2 \cdot \text{H}_2\text{O}$.

SOLUBILITY IN WATER.

(Pajetta, 1906.)

t°.	15.7°.	24.7°.	31.4°.	40.9°.
Gms. $\text{Sr}(\text{C}_7\text{H}_5\text{O}_2)_2$ per 100 Gms. Solution	5.31	5.4	5.56	5.77

STRONTIUM BENZOATES.

SOLUBILITY OF SEVERAL STRONTIUM BENZOATES IN WATER AT 20°.

(Ephraim and Pfister, 1925.)

Compound.	Formula.	Gms. anhydrous compd. per 100 cc. sat. sol.
Strontium Benzoate.....	$(\text{C}_6\text{H}_5\text{COO})_2\text{Sr} \cdot \text{H}_2\text{O}$	4.953
" -4 Chloro Benzoate..	$(\text{C}_6\text{H}_4\text{ClCOO})_2\text{Sr} \cdot 4\text{H}_2\text{O}$	1.341
" -4 Methoxy "	$(\text{C}_6\text{H}_5\text{OCH}_2\text{COO})_2\text{Sr} \cdot \text{H}_2\text{O}$	1.6975
" -4 Nitro "	$(\text{C}_6\text{H}_4\text{NO}_2\text{COO})_2\text{Sr} \cdot 8\text{H}_2\text{O}$	1.340
" -4 Oxy "	$(\text{C}_6\text{H}_4\text{OHCOO})_2\text{Sr} \cdot \text{H}_2\text{O}$	11.098

SOLUBILITY OF STRONTIUM HALOGEN BENZOATES IN 94 PERCENT ACETONE AT ABOUT 20°.
(Ballar, 1931.)

Compound	Formula	Gm. mols. compound per liter
Strontium p Brom Benzoate	$(\text{C}_6\text{H}_4\text{BrCOO})_2\text{Sr}$	0.00028
" p Chlor "	$(\text{C}_6\text{H}_4\text{ClCOO})_2\text{Sr}$	0.0010
" p Iodo "	$(\text{C}_6\text{H}_4\text{ICOO})_2\text{Sr}$	0.00026

STRONTIUM SALICYLATE $(\text{C}_6\text{H}_4\text{OH.COO})_2\text{Sr} \cdot 2\text{H}_2\text{O}$.

100 gms. sat. solution in water contain 3.04 gms. $(\text{C}_6\text{H}_4\text{OHCOO})_2\text{Sr}$ at 15° and 20.44 gms. at 100°.
(Tarugi and Checchi, 1901.)

SOLUBILITY OF STRONTIUM SALICYLATE IN. AQUEOUS ALCOHOL AT 25°.
(Seidell, 1909, 1930.)

Wt. % $\text{C}_2\text{H}_5\text{OH}$ in Solvent.	d ₂₅ of Sat. Sol.	Gms. $(\text{C}_6\text{H}_4\text{OH.COO})_2\text{Sr} \cdot 2\text{H}_2\text{O}$ per 100 Gms. Sat. Sol.	Wt. % $\text{C}_2\text{H}_5\text{OH}$ in Solvent.	d ₂₅ of Sat. Sol.	Gms. $(\text{C}_6\text{H}_4\text{OH.COO})_2\text{Sr} \cdot 2\text{H}_2\text{O}$ per 100 Gms. Sat. Sol.
0	1.022	5.04	60	0.923	7.15
10	1.006	4.88	70	0.893	5.90
20	0.993	5.22	80	0.859	4.40
30	0.982	6.20	90	0.824	2.56
40	0.966	7.70	92.3	0.815	2.02
50	0.948	8.08	100	0.790	0.44

The solid phase was $(\text{C}_6\text{H}_4\text{OH.COO})_2\text{Sr} \cdot 2\text{H}_2\text{O}$ in all cases except the solution in 100 per cent alcohol, in which partial dehydration and conversion of the crystalline salt to an amorphous bulky white powder occurred.

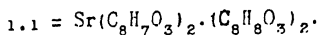
Sr STRONTIUM

1504

STRONTIUM MANDELATE (Racemic) $\text{Sr}(\text{C}_8\text{H}_7\text{O}_3)_2$.EQUILIBRIUM IN THE SYSTEM RACEMIC STRONTIUM MANDELATE,
RACEMIC MANDELIC ACID AND WATER AT 25°.

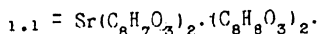
(Ross and Morrison, 1933.)

Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase
$\text{C}_8\text{H}_8\text{O}_3$	$\text{Sr}(\text{C}_8\text{H}_7\text{O}_3)_2$		$\text{C}_8\text{H}_8\text{O}_3$	$\text{Sr}(\text{C}_8\text{H}_7\text{O}_3)_2$	
16.9	0.0	$\text{C}_8\text{H}_8\text{O}_3$	3.9	1.0	1.1
17.3	0.5	$\text{C}_8\text{H}_8\text{O}_3 + 1.1$	1.4	2.2	"
14.7	0.6	1.1	1.0	2.9	"
11.6	0.5	"	0.3	3.6	$\text{Sr}(\text{C}_8\text{H}_7\text{O}_3)_2$
10.7	0.6	"	0.1	3.7	"
6.8	0.0	"	0.0	3.8	"

STRONTIUM MANDELATE (Laevo) $\text{Sr}(\text{C}_8\text{H}_7\text{O}_3)_2$.EQUILIBRIUM IN THE SYSTEM LAEVO STRONTIUM MANDELATE,
LAEVO MANDELIC ACID AND WATER AT 25°.

(Ross and Morrison, 1937.)

Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase
$\text{C}_8\text{H}_8\text{O}_3$	$\text{Sr}(\text{C}_8\text{H}_7\text{O}_3)_2$		$\text{C}_8\text{H}_8\text{O}_3$	$\text{Sr}(\text{C}_8\text{H}_7\text{O}_3)_2$	
10.1	0.0	$\text{C}_8\text{H}_8\text{O}_3$	6.0	2.9	1.1
10.3	0.9	"	4.8	3.2	"
10.4	1.8	"	2.0	5.0	"
10.7	2.4	"	1.2	6.1	"
12.7	2.6	1.1	1.3	7.4	"
11.2	2.5	"	1.6	7.7	"
9.8	2.6	"	0.8	7.0	$\text{Sr}(\text{C}_8\text{H}_7\text{O}_3)_2$
8.4	2.4	"	0.0	7.4	"
6.4	2.8	"			

STRONTIUM CINNAMATE $(\text{C}_6\text{H}_5\text{CH}:\text{CH}.\text{COO})_2\text{Sr} \cdot 2\text{H}_2\text{O}$.100 gms. H_2O dissolve 1 gm. $(\text{C}_6\text{H}_5\text{CH}:\text{CH}.\text{COO})_2\text{Sr}$ at 15°-20°.100 gms. sat. aqueous solution contain 1.18 gm. $(\text{C}_6\text{H}_5\text{CH}:\text{CH}.\text{COO})_2\text{Sr}$ at 15° and 3.11 gms. at 100°.

(Squire and Caines, 1905.)

(Tarugi and Checchi, 1901.)

STRONTIUM CINNAMATE $\text{C}_{18}\text{H}_{14}\text{O}_4\text{Sr} \cdot 4\text{H}_2\text{O}$.100 cc. sat. solution of strontium cinnamate in water contain 1.4 gms. $\text{C}_{18}\text{H}_{14}\text{O}_4\text{Sr}$ at 20°.

(Ephraim and Pfister, 1925.)

STRONTIUM SULFONATES

SOLUBILITY OF EACH SEPARATELY IN WATER.

(Ephraim and Pfister, 1925 a.)

Compound.		Formula.	t°.	Gms. anhydrous compd. per 100 cc. sat. sol.
Strontium	Benzene sulfonate			
"	Anthracene-1-	$\text{Sr}(\text{C}_6\text{H}_5\text{SO}_3)_2 \cdot 11\text{H}_2\text{O}$	20	15.493
"	Naphthalene-2-	$\text{Sr}(\text{C}_{10}\text{H}_7\text{SO}_3)_2 \cdot 3\text{H}_2\text{O}$	20	0.1157
"	"	$\text{Sr}(\text{C}_{10}\text{H}_7\text{SO}_3)_2 \cdot 11\text{H}_2\text{O}$	16.5	0.88
"	-5-Chlor-1-	$\text{Sr}(\text{C}_{10}\text{H}_6\text{SO}_3\text{Cl})_2 \cdot 3\text{H}_2\text{O}$	20	0.551
"	-6-Oxy-2-	$\text{Sr}(\text{C}_{10}\text{H}_7\text{SO}_3)_2 \cdot 6\text{H}_2\text{O}$	20	1.111
"	2,6,8, Naphthylamine disulfonate	$\text{Sr}(\text{C}_{10}\text{H}_7\text{NH}_2\text{SO}_3)_2 \cdot 11\text{H}_2\text{O}$	15	20.80*
"	2,5,7	"	15	29.48*

* Gms. anhydrous salt. per 100 gms. of saturated solution.

SOLUBILITY OF STRONTIUM BENZENE SULFONATE IN AQUEOUS SOLUTIONS
OF BENZENE SULFONIC ACID AT 25°.

(Dunn and Philip, 1934.)

Gms. per 100	gms. sat. sol.	Solid	Gms. per 100	gms. sat. sol.	Solid
$\text{C}_6\text{H}_5\text{SO}_3\text{H}$	$\text{Sr}(\text{C}_6\text{H}_5\text{SO}_3)_2$	Phase	$\text{C}_6\text{H}_5\text{SO}_3\text{H}$	$\text{Sr}(\text{C}_6\text{H}_5\text{SO}_3)_2$	Phase
0.0	15.37	$\text{Sr}(\text{C}_6\text{H}_5\text{SO}_3)_2 \cdot \text{H}_2\text{O}$	28.49	2.39	$\text{Sr}(\text{C}_6\text{H}_5\text{SO}_3)_2 \cdot \text{H}_2\text{O}$
7.93	8.51	"	41.8	0.31	"
10.56	6.43	"	44.7	0.16	"
14.12	5.10	"	49.6	0.07	"
19.29	3.26	"			

STRONTIUM Anthraquinone SULFONATES

SOLUBILITY OF EACH SEPARATELY IN WATER.

(Fierz-David, Krebsen and Anderau, 1927.)

Compound	Formula	t°	Gms. Anhydrous (?) compound per liter
Strontium Anthraquinone:			
1.5 Disulfonate	$\text{Sr}(\text{C}_{14}\text{H}_6\text{O}_2(\text{SO}_3)_2 \cdot 3\text{H}_2\text{O})$	18°	28.0
1.8 "	$\text{Sr}(\text{C}_{14}\text{H}_6\text{O}_2(\text{SO}_3)_2 \cdot 3\frac{1}{2}\text{H}_2\text{O})$	18	0.4
" "	"	100	2.0
-1- Sulfonate	$\text{SrC}_{14}\text{H}_7\text{O}_2\text{SO}_3 \cdot 3\text{H}_2\text{O}$	18	1.16
" "	"	100	7.05
-2- "	$\text{Sr}(\text{C}_{14}\text{H}_7\text{O}_2\text{SO}_3)_2 \cdot \text{H}_2\text{O}$	18	0.97
" "	"	100	5.08
2.6 Di Sulfonate	$\text{SrC}_{14}\text{H}_6\text{O}_2(\text{SO}_3)_2$	18	2.35
" "	"	100	3.80
2.7 "	$\text{SrC}_{14}\text{H}_6\text{O}_2(\text{SO}_3)_2 \cdot 2\text{H}_2\text{O}$	18	6.5
" "	"	100	13.2

STRONTIUM CAMPHORATE $\text{d C}_{10}\text{H}_{14}\text{O}_4\text{Sr} \cdot 4\text{H}_2\text{O}$.

SOLUBILITY IN AQUEOUS SOLUTIONS OF CAMPHORIC ACID AT 16-17°.

(Jungfleisch and Landrieu, 1914.)

Gms. per 100	Gms. Sat. Sol.	Solid Phase.	Gms. per 100	Gms. Sat. Sol.	Solid Phase.
$\text{C}_8\text{H}_{14}(\text{COOH})_2$	$\text{C}_{10}\text{H}_{14}\text{O}_4\text{Sr}$		$\text{C}_8\text{H}_{14}(\text{COOH})_2$	$\text{C}_{10}\text{H}_{14}\text{O}_4\text{Sr}$	
1.25	1.413	$\text{C}_8\text{H}_{14}(\text{COOH})_2$	1.20	17.99	$(\text{C}_{10}\text{H}_{14}\text{O}_4)_2\text{Sr}(\text{C}_{10}\text{H}_{14}\text{O}_4)_2$
1.03	1.7705	$(\text{C}_{10}\text{H}_{14}\text{O}_4)_2\text{Sr}(\text{C}_{10}\text{H}_{14}\text{O}_4)_2$	0	16.95	$\text{C}_{10}\text{H}_{14}\text{O}_4\text{Sr} \cdot 4\text{H}_2\text{O}$
1.13	6.525	"	0	16.56	"
1.20	12.452	"	0	12.86 (at 98°)	"

STRONTIUM HELIANTHATE $(\text{C}_{14}\text{H}_{14}\text{N}_3\text{SO}_3)_2\text{Sr} \cdot 4\text{H}_2\text{O}$.

1000 cc. H_2O dissolve 0.126 gm. $(\text{C}_{14}\text{H}_{14}\text{N}_3\text{SO}_3)_2\text{Sr} \cdot 4\text{H}_2\text{O}$ at 20-25°.

(Stark and Dehn, 1918.)

STRONTIUM CARBONATE SrCO_3 .

One liter of water dissolves 0.00082 gm. at 8.8° and 0.0109 gm. at 24° by conductivity method. (Holleman, 1893; Kohlrausch and Rose, 1893.)

One liter of water saturated with CO_2 dissolves 1.19 gms. $\text{Sr}(\text{HCO}_3)_2$.

Data for the solubility of strontium carbonate in water containing CO_2 at pressures between 0.05 and 1.1 atmospheres are given by McCoy and Smith (1911). The equilibrium constant is $k = 1.29 \times 10^{-2}$ with an average deviation from the mean of 1.2 per cent. From this value, the solubility product is calculated to be $\text{Sr} \times \text{CO}_3 = k_3 = 1.567 \times 10^{-9}$.

Sr STRONTIUM

1506

Using the "polarographic" method (See remarks under Barium carbonate) Heyrovsky and Berezicky, 1929, found the solubility of Strontium carbonate in Water to be 0.00028 gm. equivalents per liter.

SOLUBILITY OF STRONTIUM CARBONATE IN WATER SATURATED WITH CARBON DIOXIDE AT PRESSURE OF ONE ATMOSPHERE AND OF THIRTY-FIVE ATMOSPHERES AT 18°.
(Haehnel, 1924.) (See Barium Carbonate, p. 1076.)

Pressure of Carbon Dioxide.	Gms. per 100 gms. sat. sol.	
	Carbonate.	Bicarbonate.
1.0 atmosphere.....	0.12	0.17
35.0 atmosphere.....	0.38	0.57

The limit of solubility at 18° was at 25 atmospheres pressure of CO₂.

SOLUBILITY OF STRONTIUM CARBONATE IN AQUEOUS AMMONIUM CHLORIDE.
(Cantoni and Goguelia, 1905.)

Gms. NH ₄ Cl per 100 Gms. Solution.	Gms. SrCO ₃ per 1000 cc. Sat. Solution.
5.35	0.179
10	0.259
20	0.358

The mixtures were allowed to stand at 12-18° for 98 days.

Fusion-point data for SrCO₃ + SrCl₂ are given by Sackur (1911-12).

CO

SOLUBILITY OF STRONTIUM CARBONATE IN AQUEOUS SOLUTIONS
OF ALKALI CHLORIDES.

(Townley, Whitney and Felsing, 1937.)

Results at 25°

Results at 40°

Gm. Mol. Alkali Chloride per 1000 gms. H ₂ O in each case	Gm. Mol. SrCO ₃ x 10 ⁻⁴ per 1000 gms. H ₂ O in aqueous			Gm. Mol. SrCO ₃ x 10 ⁻⁴ per 1000 gms. H ₂ O in aqueous		
	LiCl	NaCl	KCl	LiCl	NaCl	KCl
0.0 (= H ₂ O alone)	0.5525	0.5525	0.5525	0.7026	0.7026	0.7026
0.02	0.957	0.737	0.672	1.164	0.888	0.975
0.05	1.203	0.965	0.835	1.494	1.140	1.190
0.10	1.455	1.320	1.055	1.845	1.505	1.415
0.20	1.750	1.965	1.375	2.260	2.195	1.690
0.30	1.925	2.485	1.570	2.525	2.780	1.870
0.40	2.040	2.915	1.685	2.717	3.280	1.980
0.50	2.135	3.285	1.756	2.870	3.710	2.055
1.00	2.440	4.415	1.900	3.390	5.145	2.205
3.0	3.405	6.855	2.176	5.060	8.665	2.480

STRONTIUM OXALATE SrC₂O₄·H₂O.

One liter of water dissolves 0.0328 gm. SrC₂O₄ at 1.35°, 0.0444 gm. at 15.9°, 0.0461 gm. at 18°, 0.0575 gm. at 31.7° and 0.0617 gm. at 37.3°, determined by the conductivity method. (Kohlrausch, 1908.)

One liter of sat. aqueous solution contains 0.057 gm. SrC₂O₄ at 0°, 0.077 gm. at 20° and 0.093 gm. at 40°. (Cantoni and Diotalevi, 1905.)

SOLUBILITY OF STRONTIUM OXALATE IN AQUEOUS ACETIC ACID SOLUTIONS
AT 26°-27°.
 (Herz and Muhs, 1903.)

Normality of Acetic Acid.	Gms. per 100 cc. Solution.		Normality of Acetic Acid.	Gms. per 100 cc. Solution.	
	CH ₃ COOH.	SrC ₂ O ₄ .H ₂ O.		CH ₃ COOH.	SrC ₂ O ₄ .H ₂ O.
0	0	0.009	3.86	23.16	0.0598
0.58	3.48	0.0526	5.79	34.74	0.0496
1.45	8.70	0.0622	16.26	97.56	0.0060
2.89	17.34	0.0642			

One liter sat. aq. solution of SrC₂O₄.H₂O contains 0.0589 gm. SrC₂O₄ at 18°, as determined by conductivity measurements. (Scholder, Gadenné and Niemann, 1927.)

Using the "polarographic" method (See remarks under Barium carbonate) Heyrovsky and Berezicky, 1929, found the solubility of Strontium Oxalate in Water to be 0.00056 gm. equivalents per liter.

EQUILIBRIUM IN THE SYSTEM STRONTIUM OXALATE, URANYL OXALATE AND WATER.
 (Colani, 1934.)

C00

Results at 15°

Results at 50°

Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid
UO ₂ C ₂ O ₄	SrC ₂ O ₄		UO ₂ C ₂ O ₄	SrC ₂ O ₄	
0.470	0.0	UO ₂ C ₂ O ₄ ·3H ₂ O	1.00	0.0	UO ₂ C ₂ O ₄ ·3H ₂ O
0.616	0.093		1.23	0.121	
0.771	0.164	SrUO ₂ (C ₂ O ₄) ₂ ·4H ₂ O	1.75	0.343	"
0.742	0.158	"	1.92	0.412	"
0.701	0.160	"	2.10	0.521	"
0.549	0.163	"	1.99	0.508	SrUO ₂ (C ₂ O ₄) ₂ ·4H ₂ O
0.481	0.147	SrC ₂ O ₄ .H ₂ O	1.82	0.500	"
0.266	0.086	"	1.45	0.477	"
0.087	0.033	"	1.32	0.435	SrC ₂ O ₄ .H ₂ O
			0.524	0.189	"
			0.349	0.128	"
			0.176	0.074	"

STRONTIUM CHLORIDE SrCl₂.6H₂O.

FREEZING-POINTS OF DILUTE SOLUTIONS OF STRONTIUM CHLORIDE.
 (Klein and Svanberg, 1920.)

t° of f. pt.	—0.485.	—1.233.	—2.584.
Normality of aq. SrCl ₂ solution	0.10	0.25	0.50

STRONTIUM CHLORIDE $\text{SrCl}_2 \cdot 6\text{H}_2\text{O}$.

SOLUBILITY IN WATER.

(Average curve from the results of Mulder; Etard; see also Tilden, 1884.)

t°.	Gms. SrCl_2 per 100 Gms.		Solid Phase.	t°.	Gms. SrCl_2 per 100 Gms.		Solid Phase.
	Solution.	Water.			Solution.	Water.	
-20	26.0	35.1	$\text{SrCl}_2 \cdot 6\text{H}_2\text{O}$	60	45.0	81.8	$\text{SrCl}_2 \cdot 6\text{H}_2\text{O}$
0	30.3	43.5	"	70	46.2	85.9	$\text{SrCl}_2 \cdot 2\text{H}_2\text{O}$
10	32.3	47.7	"	80	47.5	90.5	"
20	34.6	52.9	"	100	50.2	100.8	"
25	35.8	55.8	"	120	53.0	112.8	"
30	37.0	58.7	"	140	55.6	125.2	"
40	39.5	65.3	"	160	58.5	141.0	"
50	42.0	72.4	"	180	62.0	163.1	"

Transition temperature about 62.5°. Sp. Gr. of sat. solution at 0° = 1.334; at 15° = 1.36.

More recent determinations of the solubility of Strontium Chloride in Water, made by Menzies, 1936, by a modification of the synthetic method which permitted varying at will the amount of solvent in contact with the solute, are as follows.

Cl

t°	Gm. Mols. SrCl_2 per 1000 gms. H_2O	Solid Phase	t°	Gm. Mols. SrCl_2 per 1000 gms. H_2O	Solid Phase
20	3.33	$\text{SrCl}_2 \cdot 6\text{H}_2\text{O}$	100	6.39	$\text{SrCl}_2 \cdot 2\text{H}_2\text{O}$
25	3.50	"	110	6.74	"
30	3.69	"	120	7.17	"
40	4.10	"	130	7.74	"
50	4.62	"	134.4	8.06	" + $\text{SrCl}_2 \cdot \text{H}_2\text{O}$
60	5.35	"	140	8.20	$\text{SrCl}_2 \cdot \text{H}_2\text{O}$
61.4	5.50	" + $\text{SrCl}_2 \cdot 2\text{H}_2\text{O}$	150	8.60	"
70	5.65	$\text{SrCl}_2 \cdot 2\text{H}_2\text{O}$	160	8.74	"
80	5.86	"	180	9.39	"
90	6.10	"	200	10.29	"

SOLUBILITY OF STRONTIUM CHLORIDE IN 98.1% DEUTERIUM WATER.
(Miles and Menzies, 1937.)

t°	Gm. Mols. SrCl_2 per 1000 gms. D_2O	Solid Phase	t°	Gm. Mols. SrCl_2 per 1000 gms. D_2O	Solid Phase
0	2.78	$\text{SrCl}_2 \cdot 6\text{H}_2\text{O}$	80	5.76	$\text{SrCl}_2 \cdot 2\text{H}_2\text{O}$
10	2.91	"	90	6.02	"
20	3.36	"	100	6.34	"
25	3.54	"	110	6.72	"
30	3.73	"	120	7.18	"
40	4.17	"	128.5	7.64	" + $\text{SrCl}_2 \cdot \text{H}_2\text{O}$
50	4.76	"	130	7.68	$\text{SrCl}_2 \cdot \text{H}_2\text{O}$
56.4	5.28	" + $\text{SrCl}_2 \cdot 2\text{H}_2\text{O}$	135	7.82	"
60	5.35	$\text{SrCl}_2 \cdot 2\text{H}_2\text{O}$	140	7.97	"
70	5.54	"	145	8.14	"

SOLUBILITY OF STRONTIUM CHLORIDE IN AQUEOUS SOLUTIONS OF
HYDROCHLORIC ACID AT 25°. (Milikan, 1918.)

Gms. per 100 gms. sat. sol.		Solid Phase.	Gms. per 100 gms. sat. sol.		Solid Phase.
Sr Cl ₂ .	H Cl.		Sr Cl ₂ .	H Cl.	
35.60	0.0	Sr Cl ₂ ·6H ₂ O	6.68	18.89	Sr Cl ₂ ·6H ₂ O
33.97	0.66	"	2.11	27.14	" + Sr Cl ₂ ·2H ₂ O
27.55	4.57	"	1.29	28.23	Sr Cl ₂ ·2H ₂ O
9.86	16.12	"	0.13	37.66	"

EQUILIBRIUM IN THE SYSTEM STRONTIUM OXIDE, HYDROCHLORIC ACID AND WATER
AT 25°. (Milikan, 1918.)

Gms. per 100 gms. sat. sol.		Solid Phase.	Gms. per 100 gms. sat. sol.		Solid Phase.
Sr O.	H Cl.		Sr O.	H Cl.	
0.08	37.72	Sr Cl ₂ ·2H ₂ O	23.27	16.38	Sr Cl ₂ ·6H ₂ O
0.10	36.59	"	23.83	16.19	" + Sr Cl ₂ ·SrO·9H ₂ O
0.84	28.82	"	24.15	16.40	" "
1.38	28.16	" + Sr Cl ₂ ·6H ₂ O	22.88	15.33	SrO·9H ₂ O + "
1.46	28.10	Sr Cl ₂ ·6H ₂ O	23.06	15.46	" "
4.37	21.96	"	22.94	15.37	" "
6.44	20.66	"	15.19	10.16	SrO·9H ₂ O
18.01	17.24	"	9.04	5.76	"
22.20	16.29	"	0.85	0.0	"

EQUILIBRIUM IN THE SYSTEM STRONTIUM CHLORIDE, STRONTIUM OXIDE AND WATER.
(Milikan, 1917.)

Gms. per 100 gms. sat. sol.			Gms. per 100 gms. sat. sol.			Cl
Sr Cl ₂ .	Sr O.	Solid Phase.	Sr Cl ₂ .	Sr O.	Solid Phase.	
Results at 0°.			Results at 40°.			
30.68	0.0	Sr Cl ₂ .6H ₂ O	39.62	0.0	Sr Cl ₂ .6H ₂ O	
30.55	0.31	» + Sr 0.9H ₂ O	39.26	1.36	» + 1.1.9	
29.03	0.30	SrO.9H ₂ O	36.62	1.73	1.1.9	
23.74	0.29	»	36.08	1.76	»	
0.0	0.35	»	34.13	2.03	»	
Results at 23°.			32.97	2.10	»	
35.60	0.0	Sr Cl ₂ .6H ₂ O	32.07	2.47	» + Sr 0.9H ₂ O	
35.65	0.85	» + 1.1.9	29.01	1.91	SrO.9H ₂ O	
33.41	1.09	1.1.9 + SrO.9H ₂ O	28.84	1.90	»	
22.09	0.75	SrO.9H ₂ O	18.48	1.42	»	
12.52	0.86	»	0.0	1.48	»	
0.0	0.85	»	1.1.9 = Sr Cl ₂ , SrO.9H ₂ O.			

100 gms. sat. solution of strontium chloride in selenium oxychloride (Se O Cl₂) contain 5.17 gms. Sr Cl₂ at 25°. (Wise, 1923.)

SOLUBILITY OF STRONTIUM CHLORIDE IN AQUEOUS SOLUTIONS OF
HYDROCHLORIC ACID AT 0°. (Engel, 1888.)

Mg. Mols. per 10 cc. Solution.		Sp. Gr. of Solution.	Grams per 100 cc. Solution.	
$\frac{1}{2}$ Sr Cl ₂ .	HCl.		Sr Cl ₂ .	HCl.
51.6	0	1.334	40.9	0.0
44.8	6.1	1.304	35.5	2.22
37.85	12.75	1.269	30.0	4.65
27.2	23.3	1.220	21.56	8.49
22.0	28.38	1.201	17.44	10.35
14.0	37.25	1.167	11.09	13.58
4.25	52.75	1.133	3.37	19.23

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SOLUBILITY OF STRONTIUM CHLORIDE IN AQUEOUS SOLUTIONS OF HYDROBROMIC AND OF HYDROCHLORIC ACIDS AT 25°.

(Harkins and Paine, 1916.)

In Aqueous HBr.

Gms. Equiv. HBr per 1000 Gms. H ₂ O.	d_{25}° of Sat. Sol.	Gms. SrCl ₂ per 100 Gms. Sat. Sol.
0	1.4015	35.80
0.06817	1.4020	35.47
0.4191	1.4010	33.92
0.9716	1.3992	31.52
1.154	1.3995	20.78

In Aqueous HCl.

Gms. Equiv. HCl per 1000 Gms. H ₂ O.	d_{25}° of Sat. Sol.	Gms. SrCl ₂ per 100 Gms. Sat. Sol.
0.1551	1.3953	35.17
0.5162	1.3788	33.60
1.017	1.3563	31.42
2.165	1.3065	26.33
9.205	1.1498	3.055

SOLUBILITY OF STRONTIUM CHLORIDE IN AQUEOUS SOLUTIONS OF ACIDS

AND OF SALTS AT 25°.

(Harkins and Paine, 1916.)

Aqueous Solution of:	Gms. Equiv. added Salt per 1000 Gms. H ₂ O.	d_{25}° of Sat. Sol.	Gms. SrCl ₂ per 100 Gms. Sat. Sol.	Aqueous Solution of:	Gms. Equiv. added Salt per 1000 Gms. H ₂ O.	d_{25}° of Sat. Sol.	Gms. SrCl ₂ per 100 Gms. Sat. Sol.
CuCl ₂	0.7134	1.4200	34.005	KNO ₃	0.09796	1.4107	35.86
"	2.276	1.4595	30.40	"	0.4755	1.4349	35.90
HI	0.1641	1.4058	34.850	HNO ₃	0.1771	1.4038	35.52
"	0.4462	1.4121	33.28	"	0.3521	1.4059	35.40
"	0.7539	1.4106	31.52	"	1.277	1.4175	34.04
KI	0.09199	1.4093	35.45	NaNO ₃	0.3621	1.4216	35.63
"	0.5401	1.4466	33.79	"	0.5010	1.4588	35.60
"	0.6015	1.4513	33.60	"	3.553	1.5214	30.88
"	1.445	1.5154	30.90	"	6.856	1.5581	25.53
KCl	0.0719	1.4032	35.62	Sr(NO ₃) ₂	0.1372	1.4113	35.42
"	0.433	1.4085	34.80	"	0.5766	1.4336	34.47
"	0.8576	1.4152	33.89	"	1.0988	1.4636	33.30
"	1.594	1.4266	32.40	"	3.318	1.6664	28.97

SOLUBILITY OF STRONTIUM CHLORIDE IN AQUEOUS

SOLUTIONS OF POTASSIUM PERMANGANATE AT 25°.

(Herz and Hiebenthal, 1929.)

Gm. Mols. per liter	Solid Phase
$\frac{1}{5} \text{K}^{\text{th}}\text{O}_4$	
0.0	SrCl ₂ · 6H ₂ O.
0.02	"
0.41	"
0.82	"
+1.36	"
$\frac{1}{2} \text{SrCl}_2$	

EQUILIBRIUM IN THE SYSTEM STRONTIUM CHLORIDE,

STRONTIUM NITRATE AND WATER AT 25°.

(Ehret, 1932.)

d. of sat. sol.	Gms. per 100 gms. Sr(NO ₃) ₂	gms. sat. sol. SrCl ₂	Solid Phase	d. of sat. sol.	Gms. per 100 gms. Sr(NO ₃) ₂	gms. sat. sol. SrCl ₂	Solid Phase
1.476	44.28	0.0	Sr(NO ₃) ₂ · 4H ₂ O	1.523	27.25	18.83	Sr(NO ₃) ₂
1.492	48.69	6.32	"	1.537	22.75	23.07	"
1.488	38.57	5.54	"	1.565	19.62	28.45	"
1.508	35.14	10.79	"	1.568	18.79	28.97	" + SrCl ₂ · 6H ₂ O
1.510	34.29	10.87	"	1.563	18.00	29.23	SrCl ₂ · 6H ₂ O
1.513	33.71	12.11	Sr(NO ₃) ₂	1.526	14.10	30.75	"
1.515	30.15	15.10	"	1.483	9.97	32.51	"
				1.403	0.0	35.82	"

100 gms. abs. methyl alcohol dissolve 63.3 gms. $\text{SrCl}_2 \cdot 6\text{H}_2\text{O}$ at 6° .

100 gms. abs. ethyl alcohol dissolve 3.8 gms. $\text{SrCl}_2 \cdot 6\text{H}_2\text{O}$ at 6° . (de Bruyn, 1892.)

SOLUBILITY OF STRONTIUM CHLORIDE IN AQUEOUS ETHYL ALCOHOL

SOLUTIONS AT 18° .

(Gerardin, 1865.)

Sp. Gr. of Aq. Alcohol at 0° .	Wt. per cent Alcohol.	Gms. SrCl_2 per 100 Gms. Alcohol.	Sp. Gr. of Aq. Alcohol at 0° .	Wt. per cent Alcohol.	Gms. SrCl_2 per 100 Gms. Alcohol.
0.990	6	49.81	0.939	45	26.8
0.985	10	47.0	0.909	59	19.2
0.973	23	39.6	0.846	86	4.9
0.966	30	35.9	0.832	91	3.2
0.953	38	30.4			

100 gms. 95% formic acid dissolve 23.8 gms. SrCl_2 at 19° . (Aschan, 1913.)

100 cc. anhydrous hydrazine dissolve 8 gms. SrCl_2 at room temp.
(Welsh and Broderson, 1915.)

The composition of the homogeneous mixture (plait point) of the system, Strontium Chloride, tertiary Butyl Alcohol and Water at 25° , was found by Ginnings, Herring and Webb, 1933, to be 6.3 percent SrCl_2 , 33.1 percent ter. $(\text{CH}_3)_3\text{COH}$ and 60.6 percent H_2O . The original results for the remaining points on the binodal curve are not given but only the values of a series of constants calculated by means of empirical equations. Cl

The binodal curve for the system Strontium Chloride, Allyl Alcohol and Water at 25° has been determined by Ginning and Dees, 1935, but the authors give only the values of a series of constants calculated from their experimental results by means of an empirical equation.

SOLUBILITY OF STRONTIUM CHLORIDE IN ANHYDROUS ACETIC ACID.

(Davidson and Chappell, 1938.)

t°	Gm. Mol. Percent SrCl_2 in sat. sol.	Solid Phase	t°	Gm. Mol. Percent SrCl_2 in sat. sol.	Solid Phase
16.60	0.0	CH_3COOH	19.0	6.11	SrCl_2
16.32	0.55	"	30.0	5.12	"
16.05	1.09	"	45.0	4.04	"
15.68	1.81	"	60.0	3.28	"
15.05	3.07	"	83.0	2.22	"
14.00	3.93	"	98.9	1.67	"
13.65	5.11	"			

Fusion-point data for $\text{SrCl}_2 + \text{SrF}_2$ are given by Plato (1907). Results for $\text{SrCl}_2 + \text{SrO}$ and $\text{SrCl}_2 + \text{SrSO}_4$ by Sackur (1911-12). Results for $\text{SrCl}_2 + \text{TiCl}_3$ by Korreng (1914) and results for $\text{SrCl}_2 + \text{ZnCl}_2$ by Sandonnini (1912a, 1914).

STRONTIUM CHLORATE $\text{Sr}(\text{ClO}_3)_2$.

100 gms. H_2O dissolve 174.9 gms. $\text{Sr}(\text{ClO}_3)_2$, or 100 gms. sat. solution contain 63.6 gms. at 18° . Sp. Gr. of solution is 1.839.
(Mylius and Funk, 1897.)

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STRONTIUM Per CHLORATE $\text{Sr}(\text{ClO}_4)_2$.

SOLUBILITY OF ANHYDROUS STRONTIUM PERCHLORATE IN SEVERAL SOLVENTS AT 25°.
(Willard and Smith, 1930)

Solvent.	$d_{25}^{\text{sol.}}$	$d_{\text{sat. sol.}}^{25}$	Gms. $\text{Sr}(\text{ClO}_4)_2$ per 100 gms.	
			sat. sol.	solvent.
Water.....	—	2.0837	75.59	309.67
Methyl alcohol.....	0.78705	1.6771	67.95	212.01
Ethyl alcohol.....	0.78517	1.5539	64.37	180.66
<i>n</i> Propyl alcohol.....	0.7989	1.4266	58.40	140.38
<i>n</i> Butyl alcohol.....	0.8059	1.3394	53.16	113.49
iso " ".....	0.7981	1.2022	43.78	77.87
Acetone.....	0.7852	1.4984	60.01	150.06
Ethyl acetate.....	0.89457	1.4717	52.10	136.93

Strontium perchlorate crystallized from water at about 0° apparently contained 4 H_2O . At about 25° a dihydrate, 2 H_2O , was obtained. Above 40° the crystals corresponded to the formula 3 $\text{Sr}(\text{ClO}_4)_2 \cdot 2 \text{H}_2\text{O}$. The transition point between this compound and the dihydrate was at about 37°. Evidence was also obtained of the possible existence of a monohydrate.

STRONTIUM Hexa Antipyrine Per CHLORATE $[\text{Sr}(\text{COC}_{10}\text{H}_{12}\text{N}_2)_6](\text{ClO}_4)_2$.

100 cc sat. solution of Strontium Hexa Antipyrine Perchlorate in Water contain 9.68 gms. $[\text{Sr}(\text{COC}_{10}\text{H}_{12}\text{N}_2)_6](\text{ClO}_4)_2$ at 20°. (Wilke-Dörfurt and Schliephake, 1929.)

CrO STRONTIUM CHROMATE SrCrO_4 .

SOLUBILITY OF STRONTIUM CHROMATE IN WATER.
(Davis and Ricci, 1930.)

Equilibrium is approached with such extreme slowness that the following results may be subject to slight revision.

t°	Gms. SrCrO_4 per liter
15	0.879 (?)
25	0.91
75	0.62
100	0.43

SOLUBILITY OF STRONTIUM CHROMATE IN SEVERAL SOLVENTS AT 15°.
(Fresenius, 1891.)

Solvent.	Gms. SrCrO_4 per 100 Gms. Solvent.	Solvent.	Gms. SrCrO_4 per 100 Gms. Solvent.
Water	0.12	Aq. Ethyl Alcohol (29%)	0.0132
Aq. NH_4Cl (5%)	0.195	Aq. Ethyl Alcohol (53%)	0.002
Aq. CH_3COOH (1%)	1.57		

STRONTIUM FLUORIDE SrF_2 .

One liter of water dissolves 0.1135 gm. SrF_2 at 0.26°, 0.1173 gm. at 17.4° and 0.1193 gm. at 27.4°, determined by the conductivity method. (Kohlrausch, 1908.)

One liter sat. solution of Strontium Fluoride in Water contains 0.39 gm. SrF_2 at 25° , determined gravimetrically and the pH of the solution is 6.2. (Carter, 1928.)

SOLUBILITY OF STRONTIUM FLUORIDE IN AQUEOUS SOLUTIONS
OF HYDROCHLORIC ACID AT 25° (?).
(Tananaew and Tchrelachwilli, 1936.)

Normality of aq. HCl	Gm. Mol. SrF_2 dissolved per liter	pH of sat. sol.
0.01	0.0038	2.20
0.10	0.0220	1.03
1.0	0.1240	0.07

STRONTIUM Hexa Antipyrine Boro FLUORIDE $\text{Sr}(\text{COC}_{10}\text{H}_{12}\text{N}_2)_6(\text{BF}_4)_2$ F

100 cc sat. solution of Strontium Hexa Antipyrine Boro fluoride in Water contain 3.8 gms. $\text{Sr}(\text{COC}_{10}\text{H}_{12}\text{N}_2)_6(\text{BF}_4)_2$ at 20° . (Wilke-Dörfurt and Mureck, 1929.)

STRONTIUM Phospho FLUORIDE $\text{SrPO}_3\text{F} \cdot \text{H}_2\text{O}$.

One liter sat. solution of Strontium Phospho Fluoride in Water contains 0.055 gm. mols. SrPO_3F at 20° . (Lange, 1929.)

STRONTIUM Silico FLUORIDE SrSiF_6 .

100 gms. of a sat. solution of strontium silico fluoride in a solvent composed of 135 cc. H_2O + 9.0 cc. of 1.0 n HCl + 1.5 gm. $(\text{NH}_4)_2\text{SiF}_6$ + 48 cc. $\text{C}_2\text{H}_5\text{OH}$ contain 1.061 gm. SrSiF_6 at 18° . 5. (Leo, 1923.)

STRONTIUM IODIDE $\text{SrI}_2 \cdot 6\text{H}_2\text{O}$.

I

SOLUBILITY IN WATER.

(Average curve from the results of Kremers, 1858; and Etard, 1874.)

t° .	Gms. SrI_2 per 100 Gms		Solid Phase.	t° .	Gms. SrI_2 per 100 Gms.		Solid Phase.
	Solution.	Water.			Solution.	Water.	
0	62.3	165.3	$\text{SrI}_2 \cdot 6\text{H}_2\text{O}$	90	78.5	365.2	$\text{SrI}_2 \cdot 2\text{H}_2\text{O}$
20	64.0	177.8	"	100	79.3	383.1	"
40	65.7	191.5	"	120	80.7	418.1	"
60	68.5	217.5	"	140	82.5	471.5	"
80	73.0	270.4	"	175	85.6	594.4	"

Transition temperature about 90° . Sp. Gr. of sat. solution at 20° = 2.15
100 gms. sat. solution of strontium iodide in absolute alcohol contain 2.6 gms. SrI_2 at -20° , 3.1 gms. at $+4^\circ$, 4.3 gms. at 39° , and 4.7 gms. at 82° . (Etard, 1874.)
Data for equilibrium in the system strontium iodide, strontium oxide and water at 25° are given by Milikau (1916).

EQUILIBRIUM IN THE SYSTEM STRONTIUM IODIDE, STRONTIUM OXIDE AND WATER
AT 25°. (Milikan, 1917.)

Gms. per 100 gms. sat. sol.		Solid Phase.	Gms. per 100 gms. sat. sol.		Solid Phase.
SrI ₂ .	SrO.		SrI ₂ .	SrO.	
64.70	0.0	SrI ₂ .6H ₂ O	53.04	0.72	SrI ₂ .2SrO.9H ₂ O
64.04	0.16	«+SrI ₂ .2SrO.9H ₂ O	49.37	0.74	»+SrO.9H ₂ O
60.77	0.18	SrI ₂ .2SrO.9H ₂ O	39.50	0.55	SrO.9H ₂ O
55.58	0.46	»	29.98	0.53	»
55.09	0.51	»	22.36	0.57	»
54.16	0.60	»	0.0	0.85	»

100 gms. sat. solution of Strontium Iodide in liquid Ammonia contain 0.308 gm. SrI₂ at 0°. (Linhard and Stephan, 1934.)

STRONTIUM PERIODIDE SrI₄.

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Data for the formation of strontium periodide in aqueous solution at 25° are given by Herz and Bulla (1911). The experiments were made by adding iodine to aqueous solutions of SrI₂ and agitating with carbon tetrachloride. From the iodine content of the CCl₄ layer the amount of iodine in the aqueous layer can be calculated on the basis of the distribution ratio of iodine between water and CCl₄. This furnishes the necessary data for calculating the amount of the strontium periodide existing in the aqueous layer.

STRONTIUM IODATE Sr(IO₃)₂.

100 gms. H₂O dissolve 0.026 gm. at 15°, and 0.72-0.91 gm. at 100°.
(Gay-Lussac; Rammelsberg, 1838.)

STRONTIUM MERCURIC IODIDE SrI₂HgI₂.8H₂O.

A saturated aqueous solution prepared by adding SrI₂ and HgI₂ in excess to warm water and filtering when the temperature had fallen to 16.5° was found to have the composition 1.0 SrI₂.1.24 HgI₂.18.09 H₂O. The *d*_{16.5} was 2.5
(Duboin, 1906.)

MnO

STRONTIUM PERMANGANATE Sr(MnO₄)₂.

100 gms. of the sat. solution in water contain about 2.5 gms. Sr(MnO₄)₂ at 0°.
(Patterson, 1906.)

STRONTIUM MOLYBDATE SrMoO₄.

100 gms. H₂O dissolve 0.0104 gm. SrMoO₄ at 17°. (Smith and Bradbury, 1891.)

STRONTIUM NITRIDE Sr(N₃)₂.

100 gms. sat. solution of Strontium Nitride in Water contain 31.43 gms. Sr(N₃)₂ at 16°. (Curtius and Rissom, 1898.)

STRONTIUM NITRITE $\text{Sr}(\text{NO}_2)_2 \cdot \text{H}_2\text{O}$.**SOLUBILITY OF STRONTIUM NITRITE IN WATER.**

(Oswald, 1912, 1914.)

t°.	Gms. $\text{Sr}(\text{NO}_2)_2$ per 100 Gms. Sat. Sol.	Solid Phase.	t°.	Gms. $\text{Sr}(\text{NO}_2)_2$ per 100 Gms. Sat. Sol.	Solid Phase.
- 1.3	11.3	Ice	35	43.1	$\text{Sr}(\text{NO}_2)_2 \cdot \text{H}_2\text{O}$
- 3.1	19.6	"	52.5	46.5	"
- 7.7	35.5	"	60.5	49.3	"
- 6.8	32.8	" + $\text{Sr}(\text{NO}_2)_2 \cdot \text{H}_2\text{O}$	65.5	50.7	"
- 2.3	33.4	$\text{Sr}(\text{NO}_2)_2 \cdot \text{H}_2\text{O}$	82.5	54	"
- 0.3	34.5	"	92	56.6	"
+ 19	39.3*	"	98	58.1	"

* $d = 1.4461$.

100 cc. sat. solution in water contain 62.83 gms. $\text{Sr}(\text{NO}_2)_2 \cdot \text{H}_2\text{O}$ at 19.5°.
 " " " " 90% alcohol " 0.42 " " 20°.
 " " " " abs. alcohol " 0.04 " " 20°.
 (Vogel, 1903.)

STRONTIUM NITRATE $\text{Sr}(\text{NO}_3)_2$.**SOLUBILITY IN WATER.**

(Berkeley and Appleby, 1911.)

t°.	d_t or Sat. Sol.	Gms. $\text{Sr}(\text{NO}_3)_2$ per 100 Gms. H_2O .	Solid Phase.	t°.	d_t of Sat. Sol.	Gms. $\text{Sr}(\text{NO}_3)_2$ per 100 Gms. H_2O .	Solid Phase.
0.58	1.28561	40.124	$\text{Sr}(\text{NO}_3)_2 \cdot 4\text{H}_2\text{O}$	39.74	1.51282	90.086	$\text{Sr}(\text{NO}_3)_2$
14.71	1.39380	60.867	"	47.73	1.51150	91.446	"
26.40	1.48831	82.052	"	61.34	1.51048	93.856	"
29.06	1.51098	87.648	"	68.96	1.51057	95.576	"
29.3*	...	...	" + $\text{Sr}(\text{NO}_3)_2$	78.98	1.51091	97.865	"
30.28	1.51441	88.577	$\text{Sr}(\text{NO}_3)_2$	88.94	1.51174	100.136	"
32.58	1.51408	88.943	"				

The determinations were made with very great accuracy.

More recent determinations by Sieverts and Petzold, 1933, showing results for the ice curve and the metastable region are as follows.

t°	Gms. $\text{Sr}(\text{NO}_3)_2$ per 100 gms. sat. sol.	Solid Phase	t°	Gms. $\text{Sr}(\text{NO}_3)_2$ per 100 gms. sat. sol.	Solid Phase
- 0.8	5.0	Ice	-14.5	44.4*	Ice
- 1.4	7.5	"	+ 0.1	28.2	$\text{Sr}(\text{NO}_3)_2 \cdot 4\text{H}_2\text{O}$
- 2.5	12.7	"	20	40.7	"
- 4.55	21.7	"	28	45.8	"
- 5.4	24.7	" + $\text{Sr}(\text{NO}_3)_2 \cdot 4\text{H}_2\text{O}$	29.3	47.0	" + $\text{Sr}(\text{NO}_3)_2$
- 6.6	28.9*	"	35.0	47.2	$\text{Sr}(\text{NO}_3)_2$
- 7.6	31.4*	"	60	48.3	"
- 8.8	35.1*	"	80	49.2	"
- 9.8	37.3*	"	105	51.2	"
- 13.2	41.9*	"	13.7	46.6*	"
- 13.9	42.6*	"	- 5.0	45.7*	"

EQUILIBRIUM IN THE SYSTEM STRONTIUM NITRATE, NITRIC ACID AND WATER.
(Sleverts and Petzold, 1933A.)

t°	Gms. per 100 gms. sat. sol.		Solid Phase	t°	Gms. per 100 gms. sat. sol.		Solid Phase
	$\text{Sr}(\text{NO}_3)_2$	HNO_3			$\text{Sr}(\text{NO}_3)_2$	HNO_3	
-25	1.14	24.66	Ice + Sr.4	15	8.34	25.95	Sr.4
"	0.69	31.4		"	7.83	27.04	" + $\text{Sr}(\text{NO}_3)_2$
"	0.57	35.1		"	3.79	33.2	$\text{Sr}(\text{NO}_3)_2$
-10	4.35	12.0	Ice	"	2.22	37.4	"
"	8.01	10.8		25	41.4	1.88	Sr.4
"	9.93	9.89*		"	37.65	4.36	"
"	9.73	10.43	" + Sr.4	"	34.6	6.29	"
"	5.99	15.6		"	33.0	7.37	"
"	3.54	20.4		"	29.2	10.05	"
"	2.49	25.45	"	"	27.2	11.6	" + $\text{Sr}(\text{NO}_3)_2$
0	23.1	3.20		"	24.85	13.1	$\text{Sr}(\text{NO}_3)_2$
"	16.9	7.4		"	14.3	21.9	"
"	10.6	13.4	"	"	10.0	25.3	"
"	5.39	21.6		"	5.03	31.8	"
"	3.12	29.5		"	4.48	32.9	"
"	2.18	35.2	" + $\text{Sr}(\text{NO}_3)_2$	"	3.44	35.1	"
"	2.02	36.9		"	2.16	38.45	"
"	1.46	39.25		"	1.36	40.2	"
"	0.56	44.8	$\text{Sr}(\text{NO}_3)_2$	50	39.55	4.99	$\text{Sr}(\text{NO}_3)_2$
"	0.08	63.6		"	28.9	11.8	"
15	25.4	8.1		"	14.5	22.65	"
"	18.5	13.4	"	"	6.03	32.7	"
"	13.3	18.6		"	2.40	40.8	"
"	10.9	21.7		"	1.15	46.0	"
				"	0.07	63.4	"

Sr.4 = $\text{Sr}(\text{NO}_3)_2 \cdot 4\text{H}_2\text{O}$.

Similar results are also given for the temperatures -15°, -8°, -5°, and +20°.

SOLUBILITY OF STRONTIUM NITRATE IN AQUEOUS ALCOHOL AT 25°.

(D'Ans and Siegler, 1913.)

Wt. % $\text{C}_2\text{H}_5\text{OH}$ in Solvent.	Gms. per 100 Gms. Sat. Sol.		Solid Phase.	Wt. % $\text{C}_2\text{H}_5\text{OH}$ in Solvent.	Gms. per 100 Gms. Sat. Sol.		Solid Phase.
	$\text{C}_2\text{H}_5\text{OH}$	$\text{Sr}(\text{NO}_3)_2$			$\text{C}_2\text{H}_5\text{OH}$	$\text{Sr}(\text{NO}_3)_2$	
0	0	44.25	$\text{Sr}(\text{NO}_3)_2 \cdot 4\text{H}_2\text{O}$	10	6	40.05	$\text{Sr}(\text{NO}_3)_2$ (unstable)
4	1.7	42.8	"	15.05	9.5	36.7	" (unstable)
6	2.6	42.1	"	18.8*	12.35	34.3	" + $\text{Sr}(\text{NO}_3)_2 \cdot 4\text{H}_2\text{O}$
10.8	4.95	40.4	"	20.6	13.8	33.2	$\text{Sr}(\text{NO}_3)_2$
16	7.95	37.6	"	40.65	32.35	20.5	"
20*	12.35	34.3	" + $\text{Sr}(\text{NO}_3)_2$	59.9	53.6	10.5	"
0	0	46.6	$\text{Sr}(\text{NO}_3)_2$ (unstable)	79.2	77.15	2.6	"
6	3.45	42.7	"	99.4	99.38	0.02	"

* Tr. pt.

100 cc. anhydrous hydrazine dissolve 5 gms. $\text{Sr}(\text{NO}_3)_2$ at room temp.

(Welsh and Broderson, 1915.)

100 cc. Pyridine dissolve 0.64 gm. $\text{Sr}(\text{NO}_3)_2$ at 0° and 0.7 gm. at 25°.

(Müller R., 1924.)

100 gms. abs. Ethyl Alcohol dissolve 0.0062 to 0.0086 gm. $\text{Sr}(\text{NO}_3)_2$ at 25°

" " " -2- Propanol " 0.0014 to 0.0023 " " " "

(Ferner and Mellon, 1934.)

STRONTIUM NITRATE

 SOLUBILITY OF STRONTIUM NITRATE IN LIQUID AMMONIA.
 (Portnow and Schurawlew, 1935.)

t°	Gms. Sr(NO ₃) ₂ per 100 gms. NH ₃	Solid Phase	t°	Gms. Sr(NO ₃) ₂ per 100 gms. NH ₃	Solid Phase
-90	4.7 (?) NH ₃ + Sr(NO ₃) ₂ · 8NH ₃		25	87.08(2)	Sr(NO ₃) ₂
-65	6.36 Sr(NO ₃) ₂ · 8NH ₃		31	85.80	"
-19.5	10.89 " " · 8NH ₃		33	87.44	"
-3.0	37.99 Sr(NO ₃) ₂ · 4NH ₃		36	101.6	"
0.0	40.39(1)		37	101.4	"
-14.0	59.46 Sr(NO ₃) ₂ · 2NH ₃ (?)		42	120.4	"
22.0	68.65 Sr(NO ₃) ₂		43.5	128.7	"

(1) = Linhard and Stephan, 1934; (2) = Hunt and Boncyk, 1933.

Fusion-point data are given for mixtures of Sr(NO₃)₂ + Sr(OH)₂ by Wolf, 1935.

STRONTIUM OXIDE SrO.

Fused SrCl₂ dissolves 18.3 gms. SrO per 100 gms. of the fused melt at 910°.
 (Arndt., 1907.)

STRONTIUM HYDROXIDE Sr(OH)₂ · 8H₂O.

OH

SOLUBILITY IN WATER. (Scheibler, 1883.)

t°.	Grams per 100 Grams Solution.		Grams per 100 cc. Solution.	
	SrO.	Sr(OH) ₂ · 8H ₂ O.	SrO.	Sr(OH) ₂ · 8H ₂ O.
0	0.35	0.90	0.35	0.90
10	0.48	1.23	0.48	1.23
20	0.68	1.74	0.68	1.74
30	1.00	2.57	1.01	2.59
40	1.48	3.80	1.51	3.87
50	2.13	5.46	2.18	5.59
60	3.03	7.77	3.12	8.00
70	4.35	11.16	4.55	11.67
80	6.56	16.83	7.02	18.01
90	12.0	30.78	13.64	34.99
100	18.6	47.71	22.85	58.61

Later determinations agreeing closely with the above are given by Grube and Nussbaum, 1928, and Ahrens, 1930.

The following results by Klinkenberg, 1929; and Reinders and Klinkenberg, 1929, differ considerably from those of other investigators at the higher temperatures.

t°	Gms. SrO per 100 gms. sat. sol.	Solid Phase	t°	Gms. SrO per 100 gms. sat. sol.	Solid Phase
25	0.85	Sr(OH) ₂ · 8H ₂ O	70	5.00	Sr(OH) ₂ · 8H ₂ O
30	1.02	"	80	8.38	"
40	1.48	"	85	12.08	" + Sr(OH) ₂ · H ₂ O
50	2.20	"	90	11.61	Sr(OH) ₂ · H ₂ O
60	3.29	"	100	10.83	"

MUTUAL SOLUBILITY OF STRONTIUM HYDROXIDE AND STRONTIUM NITRATE
IN WATER AT 25°. (Parsons and Perkins, 1910.)

d_{4}^{25} of Sat. Sol.	Gms. per 100 Gms. H ₂ O.		Solid Phase.	d_{4}^{25} of Sat. Sol.	Gms. per 100 Gms. H ₂ O.		Solid Phase.
	SrO as Sr(OH) ₂ .	Sr(NO ₃) ₂ .			SrO as Sr(OH) ₂ .	Sr(NO ₃) ₂ .	
1.481	0	79.27	Sr(NO ₃) ₂	1.267	1.11	37.81	Sr(OH) ₂ ·8H ₂ O
1.492	0.38	79.47	"	1.217	1.01	28.80	"
1.494	0.78	80.83	"	1.178	0.95	23.83	"
1.506	1.76	81.06	Sr(OH) ₂ ·8H ₂ O	1.148	0.91	17.96	"
1.490	1.71	74.27	"	1.108	0.84	12.78	"
1.419	1.51	63.71	"	1.079	0.81	8.96	"
1.381	1.41	56.30	"	1.059	0.79	6.29	"
1.327	1.27	46.97	"	1.033	0.78	4.45	"

OH

SOLUBILITY OF STRONTIUM HYDROXIDE IN AQUEOUS SOLUTIONS OF
STRONTIUM SULFHYDRATE AND VICE VERSA. (Terres and Brückner, 1920.)

Gms. per 100 gms. sat. sol.		Gms. per 100 gms. sat. sol.		Gms. per 100 gms. sat. sol.		Gms. per 100 gms. sat. sol.	
Sr(OH) ₂ .	Sr(SH) ₂ .	Sr(OH) ₂ .	Sr(SH) ₂ .	Sr(OH) ₂ .	Sr(SH) ₂ .	Sr(OH) ₂ .	Sr(SH) ₂ .
Results at 0°.		0.62	15.8	0.80	26.20	Results at 80°.	
0.41	0.00	0.60	18.3	0.42	28.30	7.78	0.00
0.30	1.56	0.55	20.3	0.30	29.25	5.60	5.60
0.25	6.68	1.00	24.0	0.10	31.60	5.00	9.50
0.22	12.65	0.25	26.0	0.00	31.60	4.88	15.50
0.20	14.80	0.20	26.8	Results at 60°.		4.10	19.60
0.16	18.20	0.15	27.5	3.63	0.00	2.70	27.50
0.15	19.05	0.00	29.7	3.15	1.60	2.10	28.00
0.10	23.40	Results at 40°.		3.04	6.08	1.40	30.40
0.10	24.80	1.75	0.00	3.16	11.85	0.05	35.60
0.20	27.5	1.65	1.40	3.15	16.72	0.00	35.60
0.00	27.50	1.60	4.87	1.75	25.0	Results at 100°.	
Results at 20°.		1.60	10.83	1.75	26.6	23.20	0.00
0.82	0.0	1.55	15.93	0.60	30.8	14.00	7.40
0.72	5.9	1.50	20.00	0.10	33.6	0.15	37.80
0.70	11.4	1.10	24.10	0.00	33.2	0.00	37.80

These results when plotted give curves composed of two branches corresponding respectively to the solid phases Sr (OH)₂·8 H₂O and Sr (SH)₂·4 H₂O.

SOLUBILITY OF STRONTIUM HYDROXIDE IN AQUEOUS SOLUTIONS AT 25°.

(Rothmund, 1910.)

Aqueous Solution of:	Mols. Sr(OH) ₂ · 8H ₂ O per Liter.	Gms. Sr(OH) ₂ per Liter.	Aqueous Solution of:	Mols. Sr(OH) ₂ · 8H ₂ O per Liter.	Gms. Sr(OH) ₂ per Liter.
Water alone		10.16	0.5 n Glycol	0.0922	11.21
0.5 n Methyl Alcohol	0.0835	9.97	" Glycerol	0.1094	13.31
" Ethyl Alcohol	0.0744	9.05	" Mannitol	0.1996	24.29
" Propyl Alcohol	0.0708	8.61	" Urea	0.0820	9.97
" Amyl Alcohol (tertiary)	0.0630	7.66	" Ammonia	0.0785	9.55
" Acetone	0.0692	8.42	" Dimethylamine	0.0586	7.13
" Ether	0.0645	7.85	" Pyridine	0.0694	8.44

Data for equilibrium in the system strontium hydroxide, phenol and water at 25° are given by van Meurs (1916).

OH

SOLUBILITY OF STRONTIUM HYDROXIDE IN AQUEOUS SOLUTIONS OF CANE SUGAR.
(Sidersky, 1921.)

The mixtures were agitated from time to time during 24 hours. The dissolved strontium hydroxide was determined by titration with 1.0 n HCl, and the sugar by polarization. The determinations were plotted and the following table constructed from the curves.

Wt. per cent of Sugar in solution.	Gms. SrO per 100 gms. sat. sol. at				Gms. Sr(OH) ₂ ·8H ₂ O per 100 gms. sat. sol. a			
	3°.	15°.	24°.	40°.	3°.	15°.	24°.	40°.
0.0...	0.39	0.57	0.80	1.48	0.98	1.46	2.05	3.80
1.0...	0.45	0.65	0.90	1.68	1.15	1.67	2.30	4.31
5.0...	0.79	1.03	1.40	2.51	2.03	2.64	3.58	6.47
10.0...	1.21	1.48	2.03	3.55	3.10	3.79	5.20	9.10
15.0...	1.64	1.94	2.66	4.58	4.21	4.97	6.81	11.75
18.0...	1.90	2.21	3.05	5.20	4.89	5.67	7.78	13.33
20.0...	2.08	2.39	3.30	—	5.33	6.13	8.45	—
25.0...	2.51	2.85	3.90	—	6.44	7.31	10.00	—

Sr STRONTIUM

1520

STRONTIUM HYDROXIDE

EQUILIBRIUM IN THE SYSTEM STRONTIUM HYDROXIDE, SUCROSE AND WATER.
(Klinkenberg, 1929; Reinders and Klinkenberg, 1929.)

Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase
SrO	C ₁₂ H ₂₂ O ₁₁		SrO	C ₁₂ H ₂₂ O ₁₁	
Results at 25°					
0.86	0.0	Sr(OH) ₂ ·8H ₂ O	3.80	4.09	Sr(OH) ₂ ·8H ₂ O
1.58	4.10*	" + 2.1	5.17	8.13	"
1.45	3.63	" + 1.1.6	2.75	0.32	" + 2.1
2.27	9.39	Sr(OH) ₂ ·8H ₂ O	1.51	2.56	2.1
3.23	14.3	"	2.15	12.7	"
4.50	20.2	"	3.57	28.1	"
5.80	25.5	"	3.44	11.57	1.1.6
6.40	28.1	"	3.26	16.2	"
1.33	4.20	1.1.6	3.45	24.6	"
1.29	8.19	"	3.80	36.9	"
1.38	12.1	"	4.42	63.6	"
1.82	23.5	"	0.01	73.1	C ₁₂ H ₂₂ O ₁₁
0.0	67.89	C ₁₂ H ₂₂ O ₁₁	2.57	73.5	
Results at 35°					
1.23	0.0	Sr(OH) ₂ ·8H ₂ O	5.78	0.0	Sr(OH) ₂ ·8H ₂ O
1.6	1.9	" + 2.1	5.99	0.2	2.1
1.8	6.7	1.1.6 + "	4.16	0.13	"
2.11	4.20*	" + Sr(OH) ₂ ·8H ₂ O	2.27	0.55	"
0.0	69.55	C ₁₂ H ₂₂ O ₁₁	1.63	3.74	"
Results at 45°					
1.81	0	Sr(OH) ₂ ·8H ₂ O	1.88	7.72	"
1.95	0.6	" + 2.1	2.38	14.92	"
2.35	14.0	1.1.6 + "	3.25	23.65	"
3.0	5.1*	" + Sr(OH) ₂ ·8H ₂ O	4.25	33.35	"
4.0	72.0	" + C ₁₂ H ₂₂ O ₁₁	5.60	46.80	"
0.0	71.3	C ₁₂ H ₂₂ O ₁₁	4.15	31.31	" + 1.1
1.51	2.50†	1.2	3.68	32.2	1.1
2.42	8.0†	1.1.6	3.95	44.56	"
Results at 55°					
2.68	0	Sr(OH) ₂ ·8H ₂ O	3.41	53.69	"
3.25	2.16		2.94	65.43	"
			2.33	75.5	" + C ₁₂ H ₂₂ O ₁₁
			2.26	78.63	C ₁₂ H ₂₂ O ₁₁
			1.06	79.25	
			0.0	78.58	

* = Metastable

† = Congruently saturated

2.1 = $2SrO \cdot C_{12}H_{22}O_{11}$; 1.1.6 = $SrO \cdot C_{12}H_{22}O_{11} \cdot 6H_2O$; 1.1 = $SrO \cdot C_{12}H_{22}O_{11}$.
(1) Niskizawa and Hachihama, 1929.

The results upon this system by Grube and Nussbaum, 1928, are considered by Reinders and Klinkenberg to be in error.

STRONTIUM PHOSPHATES (Mono) $\text{SrH}_4(\text{PO}_4)_2$, (Di) Sr_2HPO_4 .

EQUILIBRIUM IN THE SYSTEM STRONTIUM OXIDE,
PHOSPHORUS PENTOXIDE AND WATER AT 25°.
(Tartar and Lorah, 1929.)

d. of	Gms. per 100	gms. sat. sol.	Solid	d. of	Gms. per 100	gms. sat. sol.	Solid
sat. sol.	SrO	P ₂ O ₅	Phase	sat. sol.	SrO	P ₂ O ₅	Phase
1.687	0.05	61.97	$\text{SrH}_4(\text{PO}_4)_2$	1.351	9.25	23.58	$\text{SrH}_4(\text{PO}_4)_2$
1.594	0.13	56.49	"	1.294	7.84	20.79	Sr_2HPO_4
1.527	0.44	51.07	"	1.278	7.52	19.81	"
1.455	1.78	43.80	"	1.230	6.53	16.66	"
1.418	3.24	38.73	"	1.194	6.32	13.41	"
1.410	4.61	35.90	"	1.169	5.11	12.70	"
1.394	6.52	31.65	"	1.112	4.13	7.80	"
1.379	8.08	27.63	"	1.083	3.18	6.02	"
1.360	8.42	25.92	"	1.074	2.67	5.68	"
1.357	8.88	24.71	"				

STRONTIUM Methyl, Ethyl, etc. PHOSPHATES.

SOLUBILITY OF EACH SEPARATELY IN WATER. (Bailly, 1919.)

Constant agitation was not employed for securing saturation. The solutions were analyzed by evaporating to dryness and weighing the residues.

Compound.	Formula.	t°.	Gms. hydrated compd. per 100 gms. sat. sol.
Strontium Methyl Phosphate	$\text{SrCH}_3\text{PO}_4 \cdot \text{H}_2\text{O}$	14	1.24
" "	"	50	0.75
" "	"	100	0.38
" " (Acid Salt.)	$\text{Sr}[\text{CH}_3\text{HPO}_4]_2 \cdot \text{H}_2\text{O}$	17	27.15
" Ethyl	$\text{Sr} \cdot \text{C}_2\text{H}_5\text{PO}_4 \cdot 2\text{H}_2\text{O}$	20	1.29
" Propyl	$\text{Sr} \cdot \text{C}_3\text{H}_7\text{PO}_4 \cdot 2\text{H}_2\text{O}$	18.5	1.96
" Allyl	$\text{Sr} \cdot \text{CH}_2\text{CH}:\text{CH}_2\text{PO}_4 \cdot \text{H}_2\text{O}$	20	1.80
" Iso propyl	$\text{SrCH} \begin{smallmatrix} \text{CH}_3 \\ \text{CH}_3 \end{smallmatrix} \text{PO}_4 \cdot 2\text{H}_2\text{O}$	20	0.40
" Iso butyl	$\text{SrCH}_2 \cdot \text{CH} \begin{smallmatrix} \text{CH}_3 \\ \text{CH}_3 \end{smallmatrix} \text{PO}_4 \cdot 2\text{H}_2\text{O}$	18	0.89

STRONTIUM Glycero PHOSPHATES.

SOLUBILITY OF EACH SEPARATELY IN WATER. (Bailly, 1916; Bailly and Gaumé, 1924.)

Compound.	Formula.	t°.	Gms. anhy. compd. per 100 gms. sat. sol.
Strontium α glycerophosphate (cryst.)	$\text{Sr}(\text{C}_3\text{H}_5)(\text{OH})_2\text{PO}_4$	16....	1.73
" β "	$\text{Sr}(\text{C}_3\text{H}_5)(\text{OH})_2\text{PO}_4 \cdot 2\text{H}_2\text{O}$	17....	2.31
" neutral "	$\text{SrC}_3\text{H}_4(\text{OH})\text{PO}_4 \cdot \text{H}_2\text{O}$	16....	1.28
" " "	"	55....	0.58

100 gms. H_2O dissolve 2.69 gms. anhydrous strontium neutral glycerophosphate at 18°.
(H. Rogier, *These*, Paris, 1912.)

100 gms. sat. solution of $\text{Sr}(\text{C}_3\text{H}_5)(\text{OH})_2\text{PO}_4 \cdot 2\text{H}_2\text{O}$ in water contain 2.09 gm. $\text{Sr}(\text{C}_3\text{H}_5)(\text{OH})_2\text{PO}_4$ at 18° and 0.8 gm. at 65°. (Rogier and Fiore, 1913.)

STRONTIUM SULFATE SrSO_4 .

One liter of water dissolves 0.1133 gm. SrSO_4 at 2.85° , 0.1143 gm. at 17.4° and 0.1143 gm. at 32.3° , determined by the conductivity method. (Kohlrausch, 1908.)

Using the "Polarographic" method (see remarks under Barium Carbonate) Heyrovsky and Berezicky, 1929, found the solubility of Strontium Sulfate in water and dilute aqueous HCl to be:

Normality of aq. HCl	Gm. Equiv. SrSO_4 dissolved per liter
0.0 (= H_2O)	0.0015
0.001	0.0011
0.01	0.0018

**SOLUBILITY OF PRECIPITATED STRONTIUM SULFATE AND OF CALCINED
"CELESTINA" (96.67% SrSO_4) IN WATER.**
(Gallo, 1935.)

t°	Gms. SrSO_4 per 100 cc sat. sol.		t°	Gms. SrSO_4 per 100 cc sat. sol.	
	Solid Phase Pptd. SrSO_4	Solid Phase "Celestina"		Solid Phase Pptd. SrSO_4	Solid Phase "Celestina"
5	0.0121	0.0119	60	0.0131	0.0125
10	0.0129	0.0123	70	0.0123	0.0119
20	0.0132	0.0132	80	0.0116	0.0111
30	0.0138	0.0136	90	0.0115	0.0107
40	0.0141	0.0136	95	0.0113	0.0108
50	0.0135	0.0128			

**SOLUBILITY OF PRECIPITATED STRONTIUM SULFATE AND
OF "CELESTINA" IN AQUEOUS SOLUTIONS OF AMMONIUM SULFATE AT 25° .**
(Gallo, 1935.)

Gms. $(\text{NH}_4)_2\text{SO}_4$ per 100 gms. aqueous solvent	Gms. SrSO_4 per 100 cc sat. sol.	
	Solid Phase Pptd. SrSO_4 cc	Solid Phase "Celestina"
2.9	0.0100	0.0097
8.5	0.0082	0.0079
15.0	0.0074	0.0074

SOLUBILITY OF STRONTIUM SULFATE IN AQUEOUS SALT SOLUTIONS.
(Gallo, 1935.)

Solvent, Aqueous 10% solution of:	Gms. SrSO_4 per 100 cc sat. sol. at:	
	20°	38°
CaCl_2	0.0313	0.0358
NH_4Cl	0.0639	0.0690
NH_4NO_3	0.0701	0.0809
NaCl	0.0630	0.0691
NaNO_3	0.0703	0.0842

SOLUBILITY OF STRONTIUM SULFATE IN AQUEOUS SOLUTIONS OF
HYDROCHLORIC, NITRIC, CHLORACETIC AND FORMIC ACIDS.

(Banthisch, 1884.)

cc. of Aq. Acid con- taining 1 Mg. Equiv. in each case.	In Aq. HCl		In Aq. HNO ₃		In Aq. CH ₂ ClCOOH		In Aq. HCOOH	
	Gms. per 100 cc. Sol.		Gms. per 100 cc. Sol.		Gms. per 100 cc. Sol.		Gms. per 100 cc. Sol.	
	HCl.	SrSO ₄ .	HNO ₃ .	SrSO ₄ .	CH ₂ Cl COOH.	SrSO ₄ .	HCOOH.	SrSO ₄ .
0.2	18.23	0.161	31.52	0.381	...	...	...	...
0.5	7.29	0.207	12.61	0.307	...	...	...	...
1.0	3.65	0.188	6.30	0.217	94.47	0.026	46.02	0.024
2.0	1.82	0.126	3.15	0.138	47.23	0.022	...	...
10.0	0.36	0.048	0.63	0.049	...	...	...	...

100 gms. 95 per cent formic acid dissolve 0.02 gm. SrSO₄ at 18.5°. (Aschan, 1913.)

SOLUBILITY OF STRONTIUM SULFATE IN SULFURIC ACID SOLUTIONS.

t°.	Conc. of H ₂ SO ₄ .	Gms. SrSO ₄ per 100 Gms. Acid.	Authority.
ord.	concentrated	5.68	(Sturve, 1870.)
"	fuming	9.77	"
"	91%	0.08	(Varenne and Paulean, 1881.)
70	Sp. Gr. 1.843 = 99%	14	(Garside, 1875.)
ord.	Absolute H ₂ SO ₄	21.7*	(Bergius, 1910.)

* per 100 cc. Sat. Sol.

SOLUBILITY OF STRONTIUM SULFATE IN AQUEOUS SALT SOLUTIONS.

(Virck, 1862.)

In Aq. NaCl.		In Aq. KCl.		In Aq. MgCl ₂ .		In Aq. CaCl ₂ .	
(a.)	(b.)	(a.)	(b.)	(a.)	(b.)	(a.)	(b.)
8.44	0.165	8.22	0.193	1.59	0.199	8.67	0.176
15.54	0.219	12.54	0.193	4.03	0.206	16.51	0.185
22.17	0.181	18.08	0.251	13.63	0.242	33.70	0.171

(a) = Gms. salt per 100 gms. aq. solution. (b) = Gms. SrSO₄ per 100 gms. solvent.

SOLUBILITY OF STRONTIUM SULFATE IN AQUEOUS SOLUTIONS OF AMMONIUM
ACETATE AT 25°.

(Marden, 1916.)

Gms. per 100 Gms. Sat. Sol.		Gms. per 100 Gms. Sat. Sol.	
CH ₃ COONH ₄ .	SrSO ₄ .	CH ₃ COONH ₄ .	SrSO ₄ .
0	0.0151	10.68	0.0942
2.13	0.0451	21.37	0.115
5.34	0.0732		

SOLUBILITY OF STRONTIUM SULFATE IN AQUEOUS CALCIUM NITRATE AT
ROOM TEMPERATURE

(Raffo and Rossi, 1915.)

Analyzed solutions of Sr(NO₃)₂, Ca(NO₃)₂ and CaSO₄ were mixed at 60° and allowed to stand at room temperature 1 to 2 days. The resulting SrSO₄ was determined and the difference between the amount found and the amount which would have resulted if all the Sr(NO₃)₂ had been converted to SrSO₄, was taken as the amount of SrSO₄ dissolved. Gradually increasing concentrations of Ca(NO₃)₂ were used.

Gms. per 100 cc. Sat. Sol.		Gms. per 100 cc. Sat. Sol.	
Ca(NO ₃) ₂ .	SrSO ₄ .	Ca(NO ₃) ₂ .	SrSO ₄ .
0.5	0.0483	4	0.1489
1	0.0619	5	0.1698
2	0.1081	6	0.1955
3	0.1275		

SOLUBILITY OF STRONTIUM SULFATE IN AQUEOUS SODIUM CARBONATE AT 25°.

(Herz, 1910.)

Freshly prepared and dried SrSO_4 was shaken 5 days with aqueous sodium carbonate solutions and the supernatant clear solutions analyzed.

Normality of Aqueous $\text{Na}_2\text{CO}_3 \left(\frac{\text{Na}_2\text{CO}_3}{2} \right)$.	Gm. Mols. per Liter Sat. Sol.	
	$\frac{\text{Na}_2\text{CO}_3}{2}$.	$\frac{\text{Na}_2\text{SO}_4}{2}$.
0.6025	0.0382	0.5643
1.205	0.076	1.129
2.41	0.153	2.257

STRONTIUM SULFATE SrSO_4 .

SOLUBILITY OF STRONTIUM SULFATE IN AQUEOUS SOLVENTS AT 19°.

(Kolthoff and Vogelenzang, 1919.)

Solvent.	Gms. SrSO_4 per liter.
Aq. 25% Ethyl alcohol.....	0.019
» 50% »	0.000
» 50% » » + 0.1 N HCl.....	0.120
» 50% » » + 0.1 N NH_4Cl	0.040

SO STRONTIUM THIOSULFATE $\text{SrS}_2\text{O}_3 \cdot 5\text{H}_2\text{O}$.

SOLUBILITY OF STRONTIUM THIO SULFATE IN WATER.

(Portillo, 1929.)

t°	Gms. SrS_2O_3 per 100 gms. sat. sol.	Solid Phase
0	8.78	$\text{SrS}_2\text{O}_3 \cdot 5\text{H}_2\text{O}$
12.8	13.82	"
27.5	21.10	"
40.0	26.80	"

100 gms. of a saturated solution of strontium thiosulfate in a solvent composed equal volumes of water and acetone contain 0.35 gm. SrS_2O_3 at 18° 5. (Leo, 1923.)

STRONTIUM Di THIONATE $\text{SrS}_2\text{O}_6 \cdot 4\text{H}_2\text{O}$.

100 gms. sat. solution of strontium dithionate in water contain 4.51 gms. SrS_2O_6 at 0°, 7.37 gms. at 10°, 10.8 gms. at 20° and 14.9 gms. at 30°. (de Baat, 1926.)

SOLUBILITY OF STRONTIUM DITHIONATE IN AQUEOUS ETHYL ALCOHOL AT 30°.

(de Baat, 1926.)

Gms. per 100 gms. sat. sol.		Solid Phase.	Gms. per 100 gms. sat. sol.		Solid Phase.
SrS_2O_6 .	$\text{C}_2\text{H}_5\text{OH}$.		SrS_2O_6 .	$\text{C}_2\text{H}_5\text{OH}$	
14.90	0.0	$\text{SrS}_2\text{O}_6 \cdot 4\text{H}_2\text{O}$	0.08	60.39	$\text{SrS}_2\text{O}_6 \cdot 4\text{H}_2\text{O}$
5.40	14.48	»	0.0012	76.13	»
0.68	37.22	»	0.000	98.53	»

STRONTIUM Tetra THIONATE $\text{SrS}_4\text{O}_6 \cdot 6\text{H}_2\text{O}$.**SOLUBILITY OF STRONTIUM TETRA THIONATE IN WATER.**

(Portillo, 1929.)

t°	Gms. SrS_4O_6 per 100 gms. sat. sol.	Solid Phase
0	19.91	$\text{SrS}_4\text{O}_6 \cdot 6\text{H}_2\text{O}$
12.9	26.33	
30.0	38.98	"

STRONTIUM (Di) TUNGSTATE $\text{SrW}_2\text{O}_7 \cdot 3\text{H}_2\text{O}$.100 cc. H_2O dissolve 0.35 gm. at 15° .

(Lefort, 1878.)

TANTALUM Potassium FLUORIDE TaK_2F_7 .**SOLUBILITY IN AQUEOUS HYDROFLUORIC AND POTASSIUM FLUORIDE SOLUTIONS.**

(Ruff and Schiller, 1911.)

The tantalum salt was purified by repeated crystallizations from pure anhydrous HF. After drying at 120° , it was shaken in platinum flasks for 3 hour periods at constant temperature with HF or KF solutions or both together. The saturated solutions were filtered by means of a platinum funnel and subjected to analysis.

Mixture Shaken in Pt. Flask.	t° .	Gms. per 100 Gms. Sat. Sol.			Solid Phase.
		TaF_5 .	KF.	HF.	
$\text{K}_2\text{TaF}_7 + \text{H}_2\text{O}$	18	0.25	0.12	0.029	$\text{K}_2\text{Ta}_2\text{O}_7\text{F}_6 + \text{K}_2\text{TaF}_7$
" + aq. 4.77% KF	18	0.10	4.79	0.074	"
" + aq. 7.35% KF	16	0.09	6.73	0.015	"
" + aq. 4.47% HF	18	1.33	0.56	4.47	K_2TaF_7
" + aq. 4.2% HF	18.5	1.24	0.52	4.2	"
" + aq. 24.3% HF	18	5.35	2.25	24.3	"
" + aq. 10.44% HF + 21.92% KF }	18	0.036	21.93	10.44	"
" + H_2O	85	2.18	1.69	0.85	$\text{K}_2\text{Ta}_2\text{O}_7\text{F}_6 + \text{K}_2\text{TaF}_7$
" + aq. 4.77% KF	85	0.06	5.27	1.17	"
" + aq. 4.47% HF	90	5.73	2.41	4.47	K_2TaF_7
" + aq. 4.2% HF	90	6	2.52	4.2	"
" + aq. 23.3% HF	90	10.9	4.59	24.3	"
" + aq. 21.92% KF + 10.44% HF }	90	1.18	22.42	10.44	"

The solid phases were identified only by their crystal forms and it is possible that still others may be present.

TERBIUM BROMATE $\text{Tb}(\text{BrO}_3)_3 \cdot 9\text{H}_2\text{O}$.**SOLUBILITY OF TERBIUM BROMATE IN WATER.**

(James et. al., 1927.)

t°	Gms. per 100 gms. sat. sol.		Solid Phase	t°	Gms. per 100 gms. sat. sol.		Solid Phase
	$\text{Tb}(\text{BrO}_3)_3 \cdot 9\text{H}_2\text{O}$	$\text{Tb}(\text{BrO}_3)_3$			$\text{Tb}(\text{BrO}_3)_3 \cdot 9\text{H}_2\text{O}$	$\text{Tb}(\text{BrO}_3)_3$	
0	39.91	30.73	$\text{Tb}(\text{BrO}_3)_3 \cdot 9\text{H}_2\text{O}$	25	57.11	43.97	$\text{Tb}(\text{BrO}_3)_3 \cdot 9\text{H}_2\text{O}$
5	43.61	33.58		30	60.29	46.42	"
10	47.28	36.41		35	63.35	48.78	"
15	50.59	38.95	"	40	66.45	51.17	"
20	53.93	41.53	"	45	69.44	53.47	"

Tb TERBIUM

1526

TERBIUM Di methyl PHOSPHATE $Tb[(CH_3)_2PO_4]_2$.

SOLUBILITY OF TERBIUM DiMETHYL PHOSPHATE IN WATER.

(Marsh, 1939.)

t°	Gms. $Tb[(CH_3)_2PO_4]_2$ per 100 gms. H_2O	Solid Phase
0	24.2	$Tb[(CH_3)_2PO_4]_2$
25	12.6	"
50	8.07	"

TERBIUM SULFATE $Tb_2(SO_4)_3 \cdot 8H_2O$.

SO 100 gms. H_2O dissolve 3.561 gms. $Tb_2(SO_4)_3 \cdot 8H_2O$ at 20° and 2.51 gms. at 40°. (Jackson and Riennacker, 1930.)

TELLURIUM Te.

100 gms. methylene iodide, CH_2I_2 , dissolve 0.1 gm. Te at 12°. (Retgers, 1893.)

DISTRIBUTION OF TELLURIUM BETWEEN AQUEOUS HYDROCHLORIC ACID AND ETHER AT ROOM TEMPERATURE.

(Mylius, 1911.)

When 1 gm. of tellurium as the chloride, $TeCl_4$, is dissolved in 100 cc. of aqueous HCl and shaken with 100 cc. of ether, the following per cents of the metal enter the ethereal layers. With 20% HCl, 34 per cent; 15% HCl, 12 per cent; 10% HCl, 3 per cent; 5% HCl, 0.2 per cent and with 1% HCl, only a trace of the tellurium.

Fusion-point curves for mixtures of tellurium and each of the following metals are given by Pelabon (1909): Sb, Sn, Pb, Ag, Au and As. Results for mixtures of Te and Zn are given by Kobayashi (1911-12).

Results for mixtures of Te + Br and Te + I are given by Damiens, 1920, 1921.

TELLURIC ACID $H_2TeO_4 \cdot 2H_2O$.

SOLUBILITY IN WATER.

(Mylius, 1901.)

t°.	Gms. H_2TeO_4 per 100 Gms. Sol.	Mols. H_2TeO_4 per 100 Mols. H_2O .	Solid Phase.	t°.	Gms. H_2TeO_4 per 100 Gms. Sol.	Mols. H_2TeO_4 per 100 Mols. H_2O .	Solid Phase.
0	13.92	1.51	$H_2TeO_4 \cdot 6H_2O$	30	33.36	4.67	$H_2TeO_4 \cdot 2H_2O$
5	17.84	2.03	"	40	36.38	5.33	"
10	26.21	3.31	"	60	43.67	7.04	"
15	32.79	4.55	"	80	51.55	9.93	"
10	25.29	3.15	$H_2TeO_4 \cdot 2H_2O$	100	60.84	14.52	"
18	28.90	3.82	"	110	67	19	"

TELLURIUM DOUBLE SALTS

SOLUBILITY OF TELLURIUM DOUBLE BROMIDES AND CHLORIDES IN AQUEOUS HYDROCHLORIC AND HYDROBROMIC ACIDS AT 22°.

(Wheeler, 1893a.)

Tellurium Double Salt.	Formula.	Solvent.	Gms. Double Salt per 100 Gms. Solvent	
			of 1.49 Sp. Gr.	of 1.08 Sp. Gr.
Te Caesium Bromide	$TeBr_4 \cdot 2CsBr$	Aq. HBr	0.02	0.13
Te Potassium Bromide	$TeBr_4 \cdot 2KBr$	"	6.57	52.90
Te Rubidium Bromide	$TeBr_4 \cdot 2RbBr$	"	0.25	3.88
Te Caesium Chloride	$TeCl_4 \cdot 2CsCl$	Aq. HCl*	0.05	0.78
Te Rubidium Chloride	$TeCl_4 \cdot 2RbCl$	"	0.34	13.09

* Sp. Gr. of Aq. HCl solutions 1.2 and 1.05 respectively.

TELLURIUM TetraIODIDE TeI_4 .

SOLUBILITY IN MIXTURES OF AQUEOUS HYDRIODIC ACID AND IODINE AT 25°.
(Menke, 1912.)

Weighed amounts of $\text{TeI}_4 + \text{I} + 65 \text{ wt. \% HI}$ solution were shaken in sealed glass tubes for 10 days. Both the clear saturated solution and the solid phase were analyzed.

Composition of Original Mixture in Gms.			Gms. per 100 Gms. Solution.		Solid Phase.
TeI_4 .	I.	64% HI.	TeI_4 .	I.	
3	1.5	19.25	12	11.7	Small amt. $\text{TeI}_4 \cdot \text{HI} \cdot 8\text{H}_2\text{O}$
2	0.5	9.61	13	0	much "
2	0.5	9.61	13.5	8.2	" "
3	3	8.99	20	21.8	small amt. "
Excess	None	5 (cc.)	9	0.19	$\text{TeI}_4 \cdot \text{HI} \cdot 8\text{H}_2\text{O}$
2	9	9.10	10	52.4	Iodine
4	10	9.27	15	47.7	"
3	7	9.02	17.5	47.9	"
None	Excess	5 (cc.)	None	61.1	"

TELLURIUM OXIDE TeO_2 .

SOLUBILITY OF TELLURIUM OXIDE IN AQUEOUS SOLUTIONS OF HYDROCHLORIC ACID
AT 18°. (Kasarnawsky, 1924.)

The determinations were made by the conductivity method.

Mols. HCl per liter.	Mols. TeO_2 per liter.	Solid Phase.	Mols. HCl per liter	Mols. TeO_2 per liter.	Solid Phase.
0.10	$0.57 \cdot 10^{-3}$		0.46	$3.70 \cdot 10^{-3}$	
0.22	1.20 "	"	0.92	9.10 "	"

SOLUBILITY OF TELLURIUM DIOXIDE IN AQUEOUS SOLUTIONS OF
HYDROBROMIC AND OF HYDROCHLORIC ACIDS AT 12°.

(Parker and Robinson, 1931.)

Results for Aq. HBr

Results for Aq. HCl

Gm. Mols. per liter		Gm. Mols. per liter		Gm. Mols. per liter		Gm. Mols. per liter	
TeO_2	HBr	TeO_2	HBr	TeO_2	HBr	TeO_2	HBr
0.0199	0.735	0.471	3.140	0.019	0.83	1.86	7.34
0.070	1.115	0.569	3.496	0.14	1.70	2.42	8.22
0.103	1.396	0.852	5.082	0.52	4.69	3.42	12.38
0.144	1.719	1.137	6.320	0.82	6.80	4.53	16.65
0.265	2.298	1.667	9.170	1.30	6.30	3.13	15.07

In the case of the aq. HBr solutions the solid phase showed a progressive increase in Br content but did not reach that required for tellurium tetra bromide. The course of the reaction with HBr is different from that with HCl.

SOLUBILITY OF TELLURIUM DIOXIDE IN AQUEOUS SOLUTIONS OF HYDRO-
FLUORIC ACID AT 10°.

(Prideaux and Millott, 1929.)

Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase
HF	TeO ₂		HF	TeO ₂	
0.22	0.12	TeO ₂	15	42	TeO ₂
2.5	5.0	"	17.5	52.5	"
5.0	10.0	"	20.0	65	"
7.5	16.0	"	24	42.6	TeF ₄ ·TeO ₂ ·2H ₂ O
10.0	22.5	"	26.4	45.7	" + TeF ₄ ·TeO ₂ ·H ₂ O
12.5	30.0	"	28.5	58.0	TeF ₄ ·TeO ₂ ·H ₂ O

The authors' quite irregular results for solutions in contact with TeO₂ were plotted and the above values taken from the average curve drawn through them.

α Di Methyl TELLURONIUM Di IODIDE Te(CH₃)₂I₂.

SOLUBILITY OF α DI METHYL TELLURONIUM DI IODIDE IN
SEVERAL SOLVENTS AT 25°.

(Lowry and Gilbert, 1929.)

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Solvent	Gms. Te(CH ₃) ₂ I ₂ per 100 cc solvent	Solvent	Gms. Te(CH ₃) ₂ I ₂ per 100 cc solvent
Acetone	9.97	Ethyl Alcohol	2.18
Benzene	7.09	Carbon Tetrachloride	0.58
Chloroform	5.51	Cyclo Hexane	0.10
Acetonitrile	5.21		

THORIUM EMANATIONS.

Data for the solubility of thorium emanations are given by Klaus (1905).

THORIUM Th

The solubility of Thorium in Mercury was found by Parks and Prime, 1936, to be 0.0154 weight percent (= 0.0136 atomic percent) at 25°.

THORIUM BORATE.

The precipitate which results when thorium nitrate is added to a solution of borax is not a stable compound. Solubility determinations made by four successive extractions of it at 18° with water, gave the following gms. of material per 100 gms. H₂O; 0.5366, 0.1250, 0.0611 and 0.0560. After the fourth extraction, the residue then contained 10.14% B₂O₃ and after boiling 10 gms. with 100 cc. of H₂O for 6 hrs. and repeating this four times, it contained 9.63-9.81% B₂O₃. (Karl, 1910.)

THORIUM ChloroACETATES.

SOLUBILITY IN WATER AT 25°. (Karl, 1910.)

Name of Salt.	Formula.	Gms. Salt per 100 Gms. H ₂ O.
Basic Thorium Monochloroacetate	(ClCH ₂ COO) ₂ Th(OH) ₂ ·H ₂ O	0.0663
Basic Thorium Dichloroacetate	(Cl ₂ CHCOO) ₂ Th(OH) ₂	0.0887
Basic Thorium Trichloroacetate	(Cl ₃ C.COO) ₂ Th(OH) ₂	0.0091

THORIUM *m* Nitrobenzene SULFONATE $\text{Th}(\text{C}_6\text{H}_4.\text{NO}_2.\text{SO}_3)_4.7\text{H}_2\text{O}$.
100 gms. H_2O dissolve 61 gms. of the anhydrous salt at 15° . (Holmberg, 1907.)

THORIUM PICRATE $\text{Th}(\text{C}_6\text{H}_2\text{N}_3\text{O}_7)_4.10\text{H}_2\text{O}$.
100 gms. H_2O dissolve 0.3052 gm. of the salt at 25° . (Karl, 1910.)

THORIUM HIPPURATE $\text{Th}(\text{C}_6\text{H}_5.\text{CO}.\text{CH}_2.\text{NH}.\text{COO})_4$.
100 gms. H_2O dissolve 0.0318 gm. of the salt at 25° . (Karl, 1910.)

THORIUM OXALATE $\text{Th}(\text{C}_2\text{O}_4)_2.6\text{H}_2\text{O}$.

SOLUBILITY OF THORIUM OXALATE IN AQUEOUS SOLUTIONS OF
HYDROCHLORIC ACID.

Results at 17° . (Colani, 1913.)		Results at 25° . (Hauser and Wirth, 1912.)		Solid Phase.	Results at 50° . (Colani, 1913.)	
Gms. per 100 Gms. Sat. Sol.	Th $(\text{C}_2\text{O}_4)_2$.	Conc. of Aq. HCl in Per cent.	Gm. ThO ₂ per 1000 Gms. Sat. Sol.		Gms. per 100 Gms. Sat. Sol.	Th $(\text{C}_2\text{O}_4)_2$.
HCl.	Th $(\text{C}_2\text{O}_4)_2$.				HCl.	Th $(\text{C}_2\text{O}_4)_2$.
0	0.0017	24.8	0.100	$3\text{Th}(\text{C}_2\text{O}_4)_2.\text{ThCl}_4.2\text{H}_2\text{O}$	0	0.0017
1.2	0.0035	37	3.450	"	4.1	0.010
3.6	0.0061	37.6	3.492	"	8.4	0.028
4.6	0.0094				12.4	0.057
8.4	0.017				16.1	0.103
13.1	0.028				18	0.134
16.2	0.038				19.9	0.169
19.8	0.064				21.6	0.232

Data are also given for the solubility of thorium oxalate in aqueous solutions of mixtures of hydrochloric and oxalic acids at the above temperatures.

SOLUBILITY OF THORIUM OXALATE IN AQUEOUS SOLUTIONS OF SULFURIC
ACID AT 25° .

(Hauser and Wirth, 1909a, 1912; Wirth, 1912.)

Normality of Aq. H_2SO_4 .	Gms. ThO ₂ per 1000 Gms. Sat. Sol.	Solid Phase.	Normality of Aq. H_2SO_4 .	Gms. ThO ₂ per 1000 Gms. Sat. Sol.	Solid Phase.
0.25	0.07	$\text{Th}(\text{C}_2\text{O}_4)_2.6\text{H}_2\text{O}$	4.32	1.10	$\text{Th}(\text{C}_2\text{O}_4)_2.6\text{H}_2\text{O}$
0.5	0.14	"	4.9	1.32	"
1	0.26	"	6.175	1.513	"
2.1	0.418	"	6.885	1.794	"
3.2	0.71	"	8.45	2.473	"

SOLUBILITY OF THORIUM OXALATE AT 25° IN AQUEOUS SOLUTIONS OF :

(Spitzer, 1917.)

Sulfuric Acid.				Hydrochloric Acid.		Nitric Acid.	
Normality of Aq. H_2SO_4 .	Gm. ThO ₂ per liter.	Normality of Aq. H_2SO_4 .	Gm. ThO ₂ per liter.	Normality of Aq. HCl.	Gm. ThO ₂ per liter.	Normality of Aq. HNO_3 .	Gm. ThO ₂ per liter.
0.007	0.0008	0.49	0.053	0.04	0.0006	0.016	0.0003
0.02	0.0020	0.50	0.055	0.09	0.0017	0.06	0.0013
0.03	0.0030	0.58	0.060	0.23	0.0047	0.24	0.0045
0.06	0.0069	0.90	0.090	0.38	0.0070	0.47	0.0101
0.10	0.0120	0.98	0.108	0.48	0.0085	0.50	0.0110
0.20	0.0180	(1.00)	(0.120)	0.50	0.012	0.78	0.0144
0.40	0.0430	1.18	0.120	0.64	0.016	1.00	0.0330
0.48	0.0460			0.82	0.021		
				1.00	0.024		

The thorium oxalate was prepared from thorium nitrate by precipitation in a hot solution of oxalic acid and washing with hot water.

SOLUBILITY OF THORIUM OXALATE AT 25° IN AQUEOUS SOLUTIONS OF SULFURIC ACID SATURATED WITH CERIUM OXALATE ($\text{Ce}_2(\text{C}_2\text{O}_4)_3 \cdot 10 \text{H}_2\text{O}$). (Spitzer, 1917.)

Normality of Aq. H_2SO_4 .	Gm. ThO_2 per liter.	Normality of Aq. H_2SO_4 .	Gm. ThO_2 per liter.
0.014	0.0009	0.47	0.015
0.050	0.0030	0.63	0.019
0.100	0.0040	0.90	0.043

SOLUBILITY OF THORIUM OXALATE IN AQUEOUS SOLUTIONS OF AMMONIUM OXALATE AT 25°.

(Hauser and Wirth, 1909a, 1912.)

Gm. Mols. per 1000 Gms. Sat. Sol.	Solid Phase.	Normality of Aq. $(\text{NH}_4)_2\text{C}_2\text{O}_4$	Gms. ThO_2 per 1000 Gms. Sat. Sol.	Solid Phase.
$(\text{NH}_4)_2\text{C}_2\text{O}_4$. $\text{Th}(\text{C}_2\text{O}_4)_2$.				
0.00033 0.00005	$\text{Th}(\text{C}_2\text{O}_4)_2 \cdot 6\text{H}_2\text{O}$	0.01	0.040	$\text{Th}(\text{C}_2\text{O}_4)_2 \cdot 6\text{H}_2\text{O}$
0.00072 0.00012	"	0.10	2.203	"
0.00120 0.000208	"	0.5*	7.660	$[\text{Th}(\text{C}_2\text{O}_4)_3](\text{NH}_4)_2 \cdot 7\text{H}_2\text{O}$
0.00153 0.00026	"	0.5*	10.63	"
0.601† 0.195	$[\text{Th}(\text{C}_2\text{O}_4)_3](\text{NH}_4)_2 \cdot 3\text{H}_2\text{O}$	0.5*	15.90	"
1.181† 0.427	"	0.5*	17.60	"
1.420† 0.540	"	0.5*	17.75	"
1.480† 0.563	"			

* In these cases the greater part of the ammonium salt entered the solid phase complex and it was, therefore, necessary to add additional ammonium oxalate until constant results were obtained.

† In these cases the solvent was saturated ammonium oxalate solutions containing an excess of the crystals.

A thorium ammonium oxalate of the composition $\text{Th}(\text{C}_2\text{O}_4 \cdot \text{NH}_4)_4 \cdot 4\text{H}_2\text{O}$ is described by Brauner (1898). It is partially hydrolytically decomposed in aqueous solution and a solubility determination made by analyzing the solution from which the nearly pure salt began to crystallize, showed that 100 gms. H_2O contain 90.3 gms. $\text{Th}(\text{C}_2\text{O}_4 \cdot \text{NH}_4)_4 \cdot 4\text{H}_2\text{O}$ and 9.3 gms. of $(\text{NH}_4)_2\text{C}_2\text{O}_4$ (= an additional $\frac{1}{2}$ mol. wt.)

SOLUBILITY OF THORIUM OXALATE IN AQUEOUS SOLUTIONS OF AMMONIUM OXALATE AT 25°. (Spitzen, 1917.)

Constant mechanical shaking was employed. In the case of dilute solutions two liters of solvent were used and for the more concentrated, 100 to 200 cc. A period of six hours shaking was found to be sufficient.

Gm. mols. $(\text{NH}_4)_2\text{C}_2\text{O}_4$ per liter.	Gm. ThO_2 per liter.	Gm. mols. $(\text{NH}_4)_2\text{C}_2\text{O}_4$ per liter.	Gm. ThO_2 per liter.	Gm. mols. $(\text{NH}_4)_2\text{C}_2\text{O}_4$ per liter.	Gm. ThO_2 per liter.
0.00(= water)	0.00007	0.0075	0.070	0.0300	0.600
0.0006	0.0023	0.0100	0.100	(0.0410)	(0.410)
0.0010	0.0040	0.0150	0.180	0.0500	1.000
0.0025	0.010	0.0200	0.340	(0.0900)	(5.550)
0.0050	0.040	0.0250	0.450		

SOLUBILITY OF THORIUM OXALATE IN VARIOUS AQUEOUS SOLUTIONS AT 25°. (Spitzen, 1917.)

Aq. solvent.	Gm. ThO_2 per liter.	Aq. solvent.	Gm. ThO_2 per liter.	Aq. solvent.	Gm. ThO_2 per liter.
0.1 n NH_4Cl ...	0.0003	0.5 n HBr	0.0115	0.5 n $\text{C}_4\text{H}_6\text{O}_6$...	0.0040
0.1 n $(\text{NH}_4)_2\text{SO}_4$...	0.0010	0.5 n HI	0.0112	0.5 n CCl_3COOH ...	0.0120
0.1 n NaCl	0.0002	0.5 n H_2CrO_4 ...	0.0110	0.5 n KHSO_4 ...	0.0300
0.1 n Na_2SO_4 ...	0.0006	0.5 n HClO_4	0.0130	1.0 n " ..	0.0770
		0.5 n H_3BO_3 ...	0.0001		

SOLUBILITY OF THORIUM CHLOROXYALATE, $3\text{Th}(\text{C}_2\text{O}_4)_2 \cdot \text{ThCl}_4 \cdot 2\text{H}_2\text{O}$, IN AQUEOUS HYDROCHLORIC ACID.

(Colani, 1913.)

t°.	Gms. per 100 Gms. Sat. Sol.		t°.	Gms. per 100 Gms. Sat. Sol.	
	HCl.	$\text{Th}_4(\text{C}_2\text{O}_4)_4\text{Cl}_4$		HCl.	$\text{Th}_4(\text{C}_2\text{O}_4)_4\text{Cl}_4$
12	23	0.12	50	21.2	0.29
15	26.3	0.17	50	23	0.34
12	29.9	0.27	50	26.8	0.46
15	32.5	0.48	50	29.8	0.75
12	33.1	0.53	50	32.3	1.51
15	35	1.03	50	34.6	2.59

Results are also given showing the effect of oxalic acid upon the solubility of the above salt in aqueous hydrochloric acid.

SOLUBILITY OF THORIUM OXALATE IN AQUEOUS OXALIC ACID SOLUTIONS.

Results at 25°.

(Hauser and Wirth, 1912.)

Normality of Aq. $\text{H}_2\text{C}_2\text{O}_4$.	Gm. ThO_2 per 1000 Gms. Sat. Sol.	Solid Phase.
1	0.0015	$\text{Th}(\text{C}_2\text{O}_4)_2 \cdot 6\text{H}_2\text{O}$
Sat. Solution	0.0030	" + $\text{H}_4\text{C}_4\text{O}_4 \cdot 2\text{H}_2\text{O}$

Results at 50°.

(Colani, 1913.)

Gms. per 100 Gms. Sat. Sol.	
$\text{H}_2\text{C}_2\text{O}_4$.	Th.
1.7	0.0002
9.3	0.001
23	0.003

THORIUM Hexa Antipyrine Per CHLORATE $[\text{Th}(\text{COC}_{10}\text{H}_{12}\text{N}_2)_6](\text{ClO}_4)_4$.

100 cc sat. solution of Thorium Hexa Antipyrine Per Chlorate in Water contain 0.6 gm. $[\text{Th}(\text{COC}_{10}\text{H}_{12}\text{N}_2)_6](\text{ClO}_4)_4$ at 20°. (Wilke-Dörfurt and Schliephake, 1929.)

THORIUM CHROMATE $\text{Th}(\text{CrO}_4)_2 \cdot 3\text{H}_2\text{O}$.

EQUILIBRIUM IN THE SYSTEM THORIUM OXIDE, CHROMIC ANHYDRIDE AND WATER AT 25°. (Britton, 1923.)

The solutions were saturated by constant stirring in a thermostat. The solid phases were identified by analysis according to the « rest method ».

Gms. per 100 gms. sat. sol.		Solid Phase.	Gms. per 100 gms. sat. sol.		Solid Phase.
ThO_2 .	CrO_3 .		ThO_2 .	CrO_3 .	
0.044	0.033	$\text{Th}(\text{CrO}_4)_2 \cdot 3\text{H}_2\text{O}$	23.04	40.23	$\text{Th}(\text{CrO}_4)_2 \cdot \text{CrO}_3 \cdot 3\text{H}_2\text{O}$
0.452	1.376	"	21.59	41.56	"
2.09	4.58	"	17.08	44.20	"
3.08	7.15	"	7.91	52.60	"
6.52	13.09	"	7.52	56.79	"
11.27	21.75	"	9.09	57.57	"
15.62	28.00	"	17.65	61.38	" + CrO_3
22.87	37.27	"	6.27	61.84	CrO_3
23.25	37.45	"	0.0	62.87	"
24.22	39.49	" + $\text{Th}(\text{CrO}_4)_2 \cdot \text{CrO}_3 \cdot 3\text{H}_2\text{O}$			

THORIUM FLUORIDE $\text{ThF}_4 \cdot 4\text{H}_2\text{O}$.

1000 cc. sat. solution of thorium fluoride in water contain 0.17 gm. ThO_2 at 25°. (Spitzen, 1917.)

THORIUM Potassium FLUORIDE $\text{ThK}_2\text{F}_6 \cdot 4\text{H}_2\text{O}$.

1000 cc. sat. sol. of thorium potassium fluoride in water contain 0.4 gm. ThO_2 at 25°. (Spitzen, 1917.)

Th THORIUM THORIUM NITRATE

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EQUILIBRIUM IN THE SYSTEM THORIUM NITRATE, ETHYL ETHER AND WATER AT 0° AND AT 20°. (Misciattelli, 1929.)

Two liquid layers are formed at concentration of ether greater than about 4 percent of the saturated solution at 0° and 2 percent at 20°.

H₂O rich layer

(C₂H₅)₂O rich layer

Gms. per 100 gms. sat. sol.			Gms. per 100 gms. sat. sol.			Solid Phase
(C ₂ H ₅) ₂ O	H ₂ O	Th(NO ₃) ₄	(C ₂ H ₅) ₂ O	H ₂ O	Th(NO ₃) ₄	
Results at 0°						
0.0	35.0	65.0	—	—	—	Th(NO ₃) ₄ ·6H ₂ O
4.5	28.5	67.0	41.36	13.99	44.65	Th(NO ₃) ₄ ·H ₂ O
5.21	28.89	65.90	41.27	12.78	45.95	"
—	—	—	54.50	10.50	35.0	"
—	—	—	94.2	—	5.8	Tl(NO ₃) ₄
5.0	36.50	58.50	70.0	7.0	23.0	None
4.84	46.26	48.90	87.50	4.50	8.0	"
4.99	52.63	42.40	96.08	3.33	0.33	"
4.42	54.89	41.09	98.42	1.45	0.08	"
4.53	62.35	33.10	99.56	0.41	0.02	"
4.39	72.33	23.28	99.49	0.49	0.02	"
8.3	79.66	12.09	99.92	0.07	0.01	"
11.6	88.4	—	99.0	1.0	—	"

Results at 20°

0.0	35.0	65.00	—	—	—	Th(NO ₃) ₄ ·6H ₂ O
1.92	32.50	65.52	54.10	8.40	37.50	Th(NO ₃) ₄ ·H ₂ O
—	—	—	62.47	7.33	30.3	"
—	—	—	72.5	5.0	22.5	"
—	—	—	88.58	2.19	9.22	Th(NO ₃) ₄
—	—	—	92.54	0.50	6.96	"
—	—	—	88.01	—	1.9	"
2.08	37.62	60.30	66.90	7.0	26.10	None
1.90	43.0	55.00	89.20	3.3	7.50	"
2.08	51.2	46.82	99.00	1.00	0.0	"
2.50	51.60	45.90	98.50	1.50	0.0	"
2.00	57.49	40.51	98.00	2.00	0.0	"
2.27	62.22	35.51	98.20	1.80	0.0	"
2.04	65.00	32.18	98.33	1.67	0.0	"
3.90	71.52	20.58	98.08	1.92	0.0	"
6.5	93.52	—	99.0	1.0	0.0	"

Experiments in the extraction of Thorium Nitrate from aqueous solutions of nitric acid by means of ether are described by Imrie, 1927.

100 cc of a saturated solution of Thorium Nitrate in Ethyl Ether, prepared by frequent agitation and allowing to stand over night at about 20°, contain 11.22 gms. ThO₂. A saturated ethereal solution prepared as above but using Thorium Nitrate dehydrated at 150°, contain only 3.67 gm. TeO₂ per 100 cc. (Wells, 1930.)

THORIUM NITRATE $\text{Th}(\text{NO}_3)_4 \cdot 6\text{H}_2\text{O}$.

SOLUBILITY OF THORIUM NITRATE IN WATER.
(Misciatelli, 1930.)

t°	Gms. $\text{Th}(\text{NO}_3)_4$ per 100 gms. sat. sol.	Solid Phase	t°	Gms. $\text{Th}(\text{NO}_3)_4$ per 100 gms. sat. sol.	Solid Phase
- 0.2	1.0	Ice	-35	60.6	Ice
- 1.5	9.0		-40.6	62.0	
- 4.0	20.0		-43.5	64.0	
- 6.0	33.0		-22	64.2	
- 9.0	41.0		0	65.0	
-15.0	47.7	"	+10	65.2	"
-25	55.7		20	65.6	

EQUILIBRIUM IN THE SYSTEM THORIUM NITRATE, URANYL
NITRATE AND ETHYL ETHER.
(Misciatelli, 1929.)

t°	Gms. per 100 gms. sat. sol.			Solid Phase	t°	Gms. per 100 gms. sat. sol.			Solid Phase
	$\text{UO}_2(\text{NO}_3)_2$	$\text{Th}(\text{NO}_3)_2$	$(\text{C}_2\text{H}_5)_2\text{O}$			$\text{UO}_2(\text{NO}_3)_2$	$\text{Th}(\text{NO}_3)_2$	$(\text{C}_2\text{H}_5)_2\text{O}$	
0	22	0	78	$\text{UO}_2(\text{NO}_3)_2$	20	0.0	1.5	98.5	$\text{Th}(\text{NO}_3)_2$
"	22.5	1.02	76.48	"	"	3.1	1.0	95.9	"
"	24	3.5	72.57	" + $\text{Th}(\text{NO}_3)_2$	"	5.5	0.5	94	"
"	19.2	4.5	76.3	$\text{Th}(\text{NO}_3)_2$	"	8.78	0	91.22	" + $\text{UO}_2(\text{NO}_3)_2$
"	18	5	77	"	16	17.7	1.7	80.6	" + "
"	16.5	5.6	77.9	"	19	10.5	0.4	89.1	" + "
"	12.2	7.0	81.0	"	22	8.0	—	92	" + "
"	8.2	8.3	82.5	"	25	7.37	—	92.63	" + "
"	3.0	8	89	"					
"	0	5.8	94.2	"					

THORIUM OXIDE ThO_2 .

SOLUBILITY OF THORIUM OXIDE IN VARIOUS AQUEOUS SOLUTIONS AT 25°
(Spitzer, 1917.)

Aq. solvent.	Gm. ThO_2 per liter.	Aq. solvent.	Gm. ThO_2 per liter.
Water.....	less than 0.00002	Aq. 0.8 n $\text{C}_4\text{H}_8\text{O}_4$...	0.0003
Aq. 1.0 n K_2CO_3 ..	" " 0.00002	Aq. 1.0 n HCl	0.0005
Aq. 1.0 n Na_2CO_3 ..	" " 0.00003	Aq. 1.0 n HNO_3	0.0006
Aq. 1.0 n NaOH ...	" " 0.00005	Aq. 1.0 n H_2SO_4 ...	0.0020

THORIUM PHOSPHATE $\text{ThP}_2\text{O}_6 \cdot 11\text{H}_2\text{O}$.

SOLUBILITY OF THORIUM PHOSPHATE IN AQUEOUS SOLUTIONS AT 25° .
(Spitzer, 1917.)

Aq. solvent.	Gm. ThO_2 per liter.	Aq. solvent.	Gm. ThO_2 per liter.
Aq. 1.0 n HNO_3	0.012	Aq. 1.0 n H_2SO_4	0.053
Aq. 1.0 n HCl	0.024	Aq. 1.0 n K_2CO_3	0.250

Th THORIUM

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EQUILIBRIUM IN THE SYSTEM THORIUM OXIDE, PHOSPHORIC ACID AND WATER AT 25°.

(D'Ans and Dawid, 1929.)

Gms. per 100 gms. sat. sol.			Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase
P ₂ O ₅	ThO ₂			P ₂ O ₅	ThO ₂	
4.5	trace	Th ₃ (PO ₄) ₄		30	5.0	1.2.2
9.61	0.1	"		46.1	9.34	"
16.0	0.2	"		49.0	13.3	"
20.0	0.5 (?)	" + Th(HPO ₄) ₂ · H ₂ O		50.8	19.1	"
27.1	3.3	Th(HPO ₄) ₂ · H ₂ O ²		52.0	19.8	"
43.0 (?)	22.0 *	"				

* = Metastable.

1.2.2 = ThHPO₄ · 2H₂PO₄ · 2H₂O.

PO

The authors also give the following results for solutions simultaneously saturated with Thorium Phosphate and Thorium Sulfate on the one hand and with Thorium Phosphate on the other at 45°.

Gms. Gms. per 100 gms. sat. sol.			Solid Phase
ThO ₂	P ₂ O ₅	SO ₃	
0.59	0.72	13.0	Th(SO ₄) ₂ · 4H ₂ O + ThSO ₄ · HPO ₄ · 4H ₂ O
0.71	0.73	15.1	" + "
0.65	0.77	21.4	" + "
0.26	2.1	6.29	Th ₃ (PO ₄) ₄ + "
2.5	6.8	10.8	" + "
2.9	7.6	11.2	" + "

THORIUM SULFATE Th(SO₄)₂.

SOLUBILITY IN WATER.
(Roozeboom, 1890; Demarcay, 1883.)

t°.	Gms. Th(SO ₄) ₂ per 100 Gms. H ₂ O.		Solid Phase.	t°.	Gms. Th(SO ₄) ₂ per 100 Gms. H ₂ O.		Solid Phase.
0	0.74 (R)	0.88 (D)	Th(SO ₄) ₂ · 9H ₂ O	0	1.50 (R)		Th(SO ₄) ₂ · 6H ₂ O
10	0.98	1.02	"	15	1.63		"
20	1.38	1.25	"	30	2.45		"
30	1.995	1.85	"	45	3.85		"
40	2.998	2.83	"	60	6.64		"
50	5.22 (51°)	4.86	"	17	9.41 (D)		Th(SO ₄) ₂ · 4H ₂ O
55	6.76	6.5 ±	"	40	4.04 (R)	4.5 (35° D)	
0	1.0		Th(SO ₄) ₂ · 8H ₂ O	50	2.54	1.94 (55°)	"
15	1.38			60	1.63	...	"
25	1.85		"	70	1.09	1.32 (75°)	"
44	3.71		"	95	...	0.71	"

Additional results for the .8H₂O and the .9H₂O salt, in fair agreement with the above, are given by Wyrouboff (1901).

100 gms. sat. solution of Th(SO₄)₂ · 8H₂O in Water contain 2.1 gms. Th(SO₄)₂ at 30°. (Caven, 1932.)

SO

SOLUBILITY OF THORIUM SULFATE IN AQUEOUS SOLUTIONS OF HYDROCHLORIC
ACID AND OF NITRIC ACID AT 30°.
(Koppel and Holtkamp, 1910.)

In Aq. Hydrochloric Acid.			In Aq. Nitric Acid.		
Wt. % HCl in Solvent.	Gms. Th(SO ₄) ₂ per 100 Gms. Sat. Sol.	Solid Phase.	Wt. % HNO ₃ in Solvent.	Gms. Th(SO ₄) ₂ per 100 Gms. Sat. Sol.	Solid Phase.
0	2.15	Th(SO ₄) ₂ ·8H ₂ O	0	2.15	Th(SO ₄) ₂ ·8H ₂ O
4.55	3.541	"	5.17	3.68	"
6.95	3.431	"	10.04	4.20	"
12.14	2.811	"	16.68	4.84	"
15.71	2.360	"	21.99	4.47	"
18.33	2.199	"	28.33	3.96	"
20	2.110	Th(SO ₄) ₂ ·4H ₂ O	28.51	3.88	"
20	2.141	"	33.17	3.34	Th(SO ₄) ₂ ·4H ₂ O
23.9	1.277	"	38.82	2.51	"

SOLUBILITY OF THORIUM SULFATE IN AQUEOUS SOLUTIONS OF POTASSIUM
SULFATE.
(Barre, 1911.)

Results at 16°.			Results at 75°.		
K ₂ SO ₄ .	Gms. per 100 Gms. H ₂ O. Th(SO ₄) ₂ .	Solid Phase.	K ₂ SO ₄ .	Gms. per 100 Gms. H ₂ O. Th(SO ₄) ₂ .	
0	1.39	Th(SO ₄) ₂ ·9H ₂ O	0	0.9248	
0.424	1.667	Th(SO ₄) ₂ ·K ₂ SO ₄ ·4H ₂ O	0.865	1.137	
1.004	2.193	"	1.167	1.173	
1.152	3.191	"	1.172	1.121	
1.224	2.514	"	1.270	0.907	
1.283	2.222	"	1.296	0.495	
1.348	1.706	"	1.852	0.297	
1.378	1.637	Th(SO ₄) ₂ ·2K ₂ SO ₄ ·2H ₂ O	3.117	0.201	
1.487	0.870	"	4.659	0.256	
1.844	0.370	"	5.348	0.170	
3.092	0.070	"	5.932	0.123	
4.050	0.027	Th(SO ₄) ₂ ·3½K ₂ SO ₄	7.177	0.031	
4.825	0.003	"	9.706	0.022	

SOLUBILITY OF THORIUM SULFATE IN AQUEOUS SOLUTIONS OF:

Ammonium Sulfate at 16°.

(Barre, 1911.)

(NH ₄) ₂ SO ₄ .	Gms. per 100 Gms. H ₂ O. Th(SO ₄) ₂ .	Solid Phase.
2.13	3.361	Th(SO ₄) ₂ ·9H ₂ O
4.80	5.269	"
10.02	8.947	"
16.56	13.330	" + 1.1.4
28	10.359	1.1.4
35.20	9.821	" + 1.2.2
45.14	6.592	1.2.2
49.05	5.750	"
52.88	4.583	1.3.3
69.74	1.653	"

Lithium Sulfate at 25°.

(Barre, 1912.)

Li ₂ SO ₄ .	Gms. per 100 Gms. H ₂ O. Th(SO ₄) ₂ .
0	1.722
2.57	4.13
4.93	6.20
6.98	7.95
9.23	9.68
11.13	11.05
13.18	12.54
16.12	14.52
20.49	16.02
25.18	18.87

1.1.4 = Th(SO₄)₂·(NH₄)₂SO₄·4H₂O; 1.2.2 = Th(SO₄)₂·2(NH₄)₂SO₄·2H₂O; 1.3.3 = Th(SO₄)₂·3(NH₄)₂SO₄·3H₂O.

More recent determinations upon the system Thorium Sulfate, Ammonium Sulfate and Water at 25° by Rosenheim and Zickermann, 1932, will be found under Ammonium Sulfate.

SOLUBILITY OF THORIUM SULFATE IN AQUEOUS SOLUTIONS OF:

Sodium Sulfate at 16°.

(Barre, 1910, 1911.)

Gms. per 100 Gms. H ₂ O.	
Na ₂ SO ₄ .	Th(SO ₄) ₂ .
1.094	1.743
1.960	2.387
2.98	3.962
4.11	3.375
5.79	2.136
9.35	1.379
12.24	1.169
15.36	1.048

Solid Phase.

Th(SO₄)₂·Na₂SO₄·6H₂O

"

"

"

"

"

Sulfuric Acid at 25°.

(Barre, 1912.)

Gms. per 100 Gms. H ₂ O.	
H ₂ SO ₄ .	Th(SO ₄) ₂ .
0	1.722
1.072	1.919
1.941	2.017
2.821	2.060
3.843	2.061
5.212	2.035
8.055	1.863
10.105	1.702

SOLUBILITY OF THORIUM SULFATE IN AQUEOUS SOLUTIONS OF SULFURIC ACID

Results at 25°.

(Wirth, 1912.)

Normality of Aq. H ₂ SO ₄ .	Gms. Th(SO ₄) ₂ per 100 Gms. Sat. Sol.	Solid Phase.
0	1.593	Th(SO ₄) ₂ ·9H ₂ O
1.1	1.831	"
2.16	1.488	"
4.32	0.8751	"
6.68	0.4812	"
9.68	0.1045	Th(SO ₄) ₂ ·8H ₂ O
10.89	0.0636	"
15.15	0.0308	Th(SO ₄) ₂ ·4H ₂ O

Results at 20° and at the b.-pt.

(Koppel and Holtkamp 1910.)

t°.	Wt. % H ₂ SO ₄ in Solvent.	Gms. Th(SO ₄) ₂ per 100 Gms. Sat. Sol.	Solid Phase.
20	5	1.722	Th(SO ₄) ₂ ·8H ₂ O
20	15	0.9752	"
20	25	0.3838	"
20	40	0.0103	Th(SO ₄) ₂ ·4H ₂ O
b. pt.	5	0.7407	Th(SO ₄) ₂ ·8H ₂ O
"	10	0.4808	"
"	15	0.3882	"

SO

Results at 30°. (Koppel and Holtkamp, 1910.)

Wt. % H ₂ SO ₄ in Solvent.	Gms. Th(SO ₄) ₂ per 100 Gms. Sat. Sol.	Solid Phase.	Wt. % H ₂ SO ₄ in Solvent.	Gms. Th(SO ₄) ₂ per 100 Gms. Sat. Sol.	Solid Phase.
0	2.152	Th(SO ₄) ₂ ·8H ₂ O	15.03	1.484	Th(SO ₄) ₂ ·8H ₂ O
0.466	2.055	"	23.64	0.7196	"
0.72	2.085	"	32.68	0.3364	"
1.468	2.267	"	37.80	0.077	Th(SO ₄) ₂ ·4H ₂ O
2.983	2.311	"	43.28	0.0213	"
4.38	2.367	"	45.69	0.0047	"
4.97	2.323	"	74	0.1208	"
9.95	1.961	"	80.5	0	"

SOLUBILITY OF ANHYDROUS THORIUM SULFATE IN PURE METHYL ALCOHOL.

(Gibson, Driscoll and Jones, 1923.)

t°	Gms. Th(SO ₄) ₂ per 100 gms. CH ₃ OH
15	0.029
25	0.024
35	0.019
45	0.014
55	0.010

THORIUM Thallium SULFATE 2Th(SO₄)₂·7Tl₂SO₄·3H₂O.

SOLUBILITY OF THORIUM THALLIUM SULFATE IN WATER. (Fernandez, 1925.)

t°.	Gm. ThO ₃ per 100 cc. H ₂ O.	t°.	Gm. ThO ₃ per 100 cc. H ₂ O.	t°.	Gm. ThO ₃ per 100 cc. H ₂ O.
0.....	0.280	40.....	0.584	80.....	0.712
10.....	0.340	50.....	0.658	90.....	0.690
20.....	0.415	60.....	0.696	100.....	0.630
30.....	0.500	70.....	0.714		

THORIUM SELENATE $\text{Th}(\text{SeO}_4)_2 \cdot 9\text{H}_2\text{O}$.

100 gms. H_2O dissolve 0.498 gm. $\text{Th}(\text{SeO}_4)_4$ at 0° and 1.972 gms. at 100° .
(Cleve, 1885.)

TITANIUM Ti.

The percentage of Titanium in Mercury at 20° , determined by filtering an amalgam of the metal through a sintered glass filter, was found by Irvin and Russell, 1932, to be less than 1×10^{-5} .

TITANIUM Tetra BROMIDE

Determinations of the Reciprocal Solubility of Titanium Tetra Bromide and Sulfur Dioxide, determined by the synthetic method, are given by Bond and Crone, 1934.

TITANIUM Tetra CHLORIDE TiCl_4 .

100 gms. sat. solution of titanium tetrachloride in selenium oxychloride (SeOCl_2) contains 0.75 gm. TiCl_4 at 25° .
(Wise, 1923.)

Freezing-point data are given for

TiCl_4	+ CCl_4	(Carbon tetra chloride) (Nasu, 1933.)
"	+ $\text{C}_2\text{H}_5\text{CN}$	(propionitrile) (Hertel and Demmer, 1932.)
"	+ $\text{C}_6\text{H}_5\text{CN}$	(benzo nitrile) " " "
"	+ $\text{m C}_6\text{H}_4(\text{NO}_2)_2$	(m di nitro benzene) (Hertel and Demmer, 1932.)
"	+ SO_2	(Sulfur dioxide) (Bond and Stephens, 1929.)

TITANIUM Potassium Hexa FLUORIDE TiK_2F_6 .

1000 cc. sat. solution of titanium potassium hexa fluoride in aq. 0.125 *n* hydrofluoric acid contain 0.0483 gm. mols. TiK_2F_6 at 20° .
(V. Hevesy, Christiansen and Berglund, 1925.)

TITANIUM OXIDE TiO_2 .

SOLUBILITY OF TITANIUM OXIDE IN AQUEOUS SOLUTION OF ALKALIS. (Auger, 1923.)

Solvent.	Gm. TiO_2 per liter.	Solvent.	Gm. TiO_2 per liter.
Aq. 10 per cent NaOH ...	0.02-0.025	Aq. 12 per cent KHCO_3	0.50
" 36 " " "...	0.06-0.10	" 25 " " ".....	2.75
" 10 " KOH	0.30-0.45	" saturated " ".....	7.00
" 10 " " "....	0.70-0.90	" 30 per cent K_2CO_3	0.02
" 10 " NaHCO_3 .	0.25	" saturated " ".....	0.30

The temperature is not stated and the manner in which the determinations were made is not clearly described.

THALLIUM BORATES, $TlBO_2$, Tl_3BO_3 and $Tl_4B_2O_5$.

Freezing-point data, for the system $Tl_2O + B_2O_3$, which show the formation of the above three compounds are given by Canneri and Morelli, 1922.

THALLI-THALLO BROMIDES, $TlBr$, $TlBr_3$, $[TlBr_6]Tl_3$, $[TlBr_4]Tl$.

SOLUBILITY OF THALLI-THALLO BROMIDES IN WATER. (Benrath, 1924.)

Gms. per 100 gms. H_2O			Gms. per 100 gms. H_2O		
$TlBr_3$	$TlBr$	Solid Phase.	$TlBr_3$	$TlBr$	Solid Phase.
Results at 30°.			Results at 50°.		
0.0	0.073	$TlBr$ (white)	1.701	0.542	$TlBr$ (white)
0.233	0.91	"	1.992	0.670	"
1.147	0.204	"	2.351	0.669	$[TlBr_6]Tl_3$ (red)
1.556	0.272	"	3.082	0.680	"
1.990	0.356	$[TlBr_6]Tl_3$ (red)	3.591	0.738	"
2.293	0.315	"	4.110	0.879	"
2.851	0.380	"	4.251	0.926	$[TlBr_4]Tl$ (yellow)
3.490	0.379	"	4.763	0.901	"
3.865	0.448	"	5.286	0.891	"
4.163	0.435	$[TlBr_4]Tl$ (yellow)	6.632	0.880	"
5.062	0.425	"	8.511	0.874	"
6.980	0.415	"	10.256	0.883	"
9.241	0.403	"	13.056	0.851	"
11.917	0.349	"	15.554	0.941	"
14.596	0.364	"			Results at 80°.
15.721	0.389	"	6.020	2.801	$TlBr$ (white)
			6.211	2.972	$[TlBr_6]Tl_3$ (red)
			7.515	3.250	"
			8.014	3.193	$[TlBr_4]Tl$ (yellow)
					Results at 90°.
			8.234	3.741	$TlBr$ (white)
			8.980	4.520	$[TlBr_6]Tl_3$ (red)
			9.54	4.995	$[TlBr_4]Tl$ (yellow)

Br

THALLIUM BROMIDE $TlBr$.**SOLUBILITY OF THALLIUM BROMIDE IN WATER.**

The results of Kohlrausch, 1908; Noyes, 1890; and Osborg, 1926, were plotted and the following results taken from the curve. The results above 100° are by Benrath, Gjedebø, Schiffrers and Wunderlich, 1937.

t°	Gms. $TlBr$ per liter sat. sol.	Solid Phase	t°	Gms. $TlBr$ per liter sat. sol.	Solid Phase
0	0.22	$TlBr$	162	1.73	$TlBr$
10	0.32	"	215	3.09	"
20	0.48	"	258	4.45	"
25	0.57	"	269	6.2	"
30	0.68	"	294	7.27	"
40	0.97	"	414	85.5	"
50	1.32	"	421	92.0	"
70	2.50	"	457 m.pt.	100.0	"

**SOLUBILITY OF THALLIUM BROMIDE IN AQUEOUS SOLUTIONS OF THALLIUM
NITRATE AT 68.5°.**

(Noyes, 1890.)

Gms. Mols. per Liter.		Gms. per Liter.	
TlNO ₃ .	TlBr.	TlNO ₃ .	TlBr.
0	0.00869	0	2.469
0.0163	0.00410	4.336	1.164
0.0294	0.00289	7.820	0.821
0.0955	0.00148	25.400	0.420

100 gms. liquid Sulfur Dioxide (SO₂) dissolve 0.017 gm. TlBr at 0°.
(Jander and Ruppolt, 1937.)

Freezing-point data for mixtures of TlBr + TlCl, TlBr + TlI and TlCl are given by Monkemeyer (1906). Results for TlCl + SnCl₂ and TlCl + ZnCl₂ are given by Korreng (1914). Results for TlBr + TlNO₃ are given by Rostkowski, 1929.)

THALLIUM BROMATE TlBrO₃.

One liter saturated aqueous solution contains 3.463 gms. TlBrO₃ at 19.9° (Böttger, 1903) and 7.355 gms. at 39.75°.
(Noyes and Abbot, 1895.)

THALLIUM METHIONATE Tl₂[CH₂(SO₃)₂].

100 gms. H₂O dissolve 6.42 gms. Tl₂[CH₂(SO₃)₂] at 25°. (Backer and Terpstra, 1929.)

THALLIUM Chlor METHIONATE Tl₂CH₃Cl(SO₃)₂.

100 gms. H₂O dissolve 0.1438 gm. mols. Tl₂CH₃Cl(SO₃)₂ at 25°. (Backer, 1930.)

THALLOUS METHOXIDE and ETHOXIDE.

SOLUBILITY OF EACH SEPARATELY IN ALCOHOL AND BENZENE AT 25°.

(Siddgwick and Sutton, 1930.)

Compound	Formula	Solvent	Gms. Compound per 100 gms. solvent
Thallos methoxide	TlOCH ₃	CH ₃ OH	1.703
" "	"	C ₆ H ₆	3.160
" ethoxide	TlOC ₂ H ₅	C ₂ H ₅ OH	9.108

Results for the Solubility of Several Thallium derivatives of β Di Ketones and ρ Ketonic Esters in n Hexane at 27° are given by Menzies and Walker, 1936.

THALLIUM ACETATE TlCH₃COO.

100 gms. Liquid Sulfur Dioxide (SO₂) dissolve 7.5 gms. TlCH₃COO at 0°.
(Jander and Ruppolt, 1937.)

Tl THALLIUM

1540

THALLIUM Racemic MANDELATE $\text{TlC}_8\text{H}_7\text{O}_3$.

EQUILIBRIUM IN THE SYSTEM RACEMIC THALLIUM MANDELATE,
RACEMIC MANDELIC ACID AND WATER AT 25° .
(Ross and Morrison, 1936.)

Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase
$\text{C}_8\text{H}_8\text{O}_3$	$\text{TlC}_8\text{H}_7\text{O}_3$		$\text{C}_8\text{H}_8\text{O}_3$	$\text{TlC}_8\text{H}_7\text{O}_3$	
0.0	7.8	$\text{TlC}_8\text{H}_7\text{O}_3$	20.9	5.8	1.1
1.0	8.1	"	24.0	6.0	"
1.9	8.5	"	22.6	6.0	" + $\text{C}_8\text{H}_8\text{O}_3$
2.8	9.5	" + 1.1	20.4	4.7	$\text{C}_8\text{H}_8\text{O}_3$
3.7	8.2	1.1	18.8	3.1	"
4.8	7.1	"	17.7	1.6	"
9.1	5.7	"	17.2	0.6	"
12.2	5.3	"	17.0	0.4	"
16.0	5.4	"	16.95	0.0	"

1.1 = $\text{TlC}_8\text{H}_7\text{O}_3 \cdot \text{C}_8\text{H}_8\text{O}_3$.

THALLIUM Laevo MANDELATE $\text{TlC}_8\text{H}_7\text{O}_3$.

EQUILIBRIUM IN THE SYSTEM LAEVO THALLIUM MANDELATE,
LAEVO MANDELIC ACID AND WATER AT 25° .
(Ross, Morrison and Johnstone, 1937.)

CH

Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase
$\text{C}_8\text{H}_8\text{O}_3$	$\text{TlC}_8\text{H}_7\text{O}_3$		$\text{C}_8\text{H}_8\text{O}_3$	$\text{TlC}_8\text{H}_7\text{O}_3$	
5.2	60.1	1.1	29.2	28.8*	$\text{C}_8\text{H}_8\text{O}_3$
3.8	52.2	"	23.0	22.0*	"
3.1	36.4	"	21.2	20.8*	"
4.5	18.1	"	17.8	16.7*	"
5.9	16.2	"	15.3	13.7	"
10.0	13.7	"	11.4	6.5	"
18.3	14.6*	"	10.4	2.4	"
19.4	17.0	" + $\text{C}_8\text{H}_8\text{O}_3$	10.1	0.0	"

* = Metastable; 1.1 = $\text{TlC}_8\text{H}_7\text{O}_3 \cdot \text{C}_8\text{H}_8\text{O}_3$.

THALLIUM PICRATE $\text{TlOC}_6\text{H}_2(\text{NO}_2)_3$.

SOLUBILITY IN WATER.
(Rabe, 1901.)

t°.	Gms. $\text{TlOC}_6\text{H}_2(\text{NO}_2)_3$ per 100 Gms. H_2O .	Solid Phase.	t°.	Gms. $\text{TlOC}_6\text{H}_2(\text{NO}_2)_3$ per 100 Gms. H_2O .	Solid Phase.
0	0.135	Monoclinic Red	45	1.04	Triclinic Yellow
18	0.36	"	47	1.10	"
30	0.575	"	50	1.205	"
40	0.825	"	60	1.73	"
47	1.14	"	70	2.43	"

100 gms. H_2O simultaneously sat. with both salts dissolve:

0.132 gm. $\text{C}_6\text{H}_2(\text{NO}_2)_3\text{OTl}$ + 0.36 gm. $\text{C}_6\text{H}_2(\text{NO}_2)_3\text{OK}$ at 0° .
0.352 " " + 0.44 " " " 15° .
0.38 " " + 0.23 " " " 20° .

(Rabe, 1901.)

SOLUBILITY OF THALLIUM PICRATE IN METHYL ALCOHOL.
(Rabe, 1901.)

t°.	Gms. TlOC ₆ H ₃ (NO ₂) ₃ per 100 Gms. CH ₃ OH.	Solid Phase.	t°.	Gms. TlOC ₆ H ₃ (NO ₂) ₃ per 100 Gms. CH ₃ OH.	Solid Phase.
0	0.39	Red Form (monoclinic)	45	1.195	Yellow Form (triclinic)
18	0.59	"	48	1.265	"
25	0.70	"	50	1.325	"
30	0.795	"	53	1.41	"
35	0.90	"	57	1.54	"
40	1.02	"	60	1.65	"
45	1.17	"	65	1.84	"
47	1.265	"			

THALLIUM OLEATE C₈H₇CH:CH(CH₃)₇COO Tl (m. pt. 83°, cor.).

THALLIUM PALMITATE CH₃(CH₂)₁₄COO Tl (m. pt. 115°-117°).

THALLIUM STEARATE CH₃(CH₂)₁₆COO Tl (m. pt. 119°, cor.).

SOLUBILITY OF EACH SEPARATELY IN WATER AND IN 96 % ETHYL ALCOHOL.
(Holde and Selim, 1925.)

The numerical results are not given but only small scale diagrams, from which the following approximate values were read.

Solubility in Water.				Solubility in 96 % Alcohol.			
	Gms. per 100 gms. sat. solution				Gms. per 100 gms. sat. solution		
t°.	Tl Oleate.	Tl Palmitate.	Tl Stearate.	Tl Oleate.	Tl Palmitate.	Tl Stearate.	
15.....	0.04	0.015	0.005	2.2	0.35	0.1	
20.....	0.05	0.025	0.006	2.5	0.4	0.1	
25.....	0.06	0.030	0.008	2.75	0.5	0.1	
30.....	0.07	0.035	0.010	3.05	0.6	0.1	
35.....	—	—	—	3.75	0.75	0.1	
40.....	0.09	0.045	0.020	7.5	1.0	0.1	
45.....	—	—	—	15.0	1.35	0.15	
50.....	0.11	0.055	0.030			0.25	
60.....	0.15	0.07	0.050			0.75	
70.....	0.20	—	0.075				
80.....	0.30	—	0.110				

100 gms. sat. solution of thallium oleate in aq. 50 % alcohol contain 0.92 gms of the salt at 15°. (Holde and Selim, 1925.)

THALLIUM LAURATE C₁₂H₂₃O₂ Tl (m. pt. 125°-6°).

100 gms. sat. sol. of thallium laurate in aq. 50 % ethyl alcohol contain 1.51 gms. C₁₂H₂₃O₂ Tl at 15°. (Halde and Takehara, 1925.)

THALLIUM MYRISTATE C₁₄H₂₇O₂ Tl (m. pt. 120°-123°.)

100 gms. sat. sol. of thallium myristate in aq. 50 % ethyl alcohol contain 0.53 gm. C₁₄H₂₇O₂ Tl at 15°. (Halde and Takehara, 1925.)

SOLUBILITY OF THALLIUM SALTS OF FATTY ACIDS, EACH DETERMINED SEPARATELY, IN ACETONE, ETHER AND IN 96 PERCENT ETHYL ALCOHOL.
(Canneri and Rigalli, 1936.)

Solvent	t°	Gms. per 100 cc of solvent					
		TL	TL	TL	TL	TL	TL
		Laurate	Myristate	Palmitate	Stearate	Oleate	Arachinate
Acetone (anhy.)	5	0.026	0.028	0.022	0.036	0.023	0.024
" "	11	0.029	0.031	0.024	0.054	0.026	0.028
" "	19	0.038	0.035	0.028	0.078	0.029	0.032
" "	28	0.065	0.048	0.036	0.143	0.078	0.039
Ethyl Ether (anhy.)	5	0.011	0.028	0.010	0.019	0.128	0.007
" " "	12.2	0.024	0.041	0.027	0.059	0.353	0.022
" " "	15.4	0.042	0.048	0.036	0.119	0.684	0.038
" " "	21	0.057	0.054	0.045	0.138	1.983	0.047
" " "	24.5	0.079	0.071	0.057	0.203	3.460	0.079
" " "	30	0.088	0.078	0.068	0.235	8.150	0.101
Ethyl Alcohol (96%)	15	—	0.559	—	—	—	0.202
" " "	21	—	0.910	—	—	—	0.186
" " "	26	—	1.272	—	—	—	0.244
" " "	32	—	2.001	—	—	—	0.361
" " "	40	—	3.456	—	—	—	0.546
" " "	45	—	4.921	—	—	—	0.796

THALLIUM CYANIDE TlCN and Double Cyanides.

SOLUBILITY IN WATER.

(Fronmüller, 1878.)

CN

Cyanide.	Formula.	Gms. Salt per 100 Gms. H ₂ O.
Tl Cyanide	TlCN	16.8 at 28.5°.
Tl Cobalti Cyanide	Tl ₃ Co(CN) ₆	3.6 at 0°; 5.86 at 9.5°; 10.04 at 19.5°.
Tl Zinc Cyanide	2TlCN.Zn(CN) ₂	8.7 at 0°; 15.2 at 14°; 29.6 at 31°.
Tl Ferro Cyanide	Tl ₄ Fe(CN) ₆ .2H ₂ O	0.37 at 18°; 3.93 at 101°. (Lamy.)

100 gms. Liquid Sulfur Dioxide dissolve 0.012 gm. TlCN at 0°. (Jander and Ruppolt, 1937.)

THALLIUM THIOCYANATE TlSCN.

SOLUBILITY IN WATER AND IN AQUEOUS SALT SOLUTIONS.

(Böttger, 1903; Noyes, 1890; Noyes and Abbott, 1895.)

CNS

One liter sat. aq. solution contains 3.154 gms. TlSCN at 20°, 3.905 gms. at 25°, and 7.269 gms. at 39.75°.

Aq. Salt Solution.	t°.	Gms. Mols. per Liter.		Gms. per Liter.	
		Salt.	TlSCN.	Salt.	TlSCN.
Thallium Bromate TlBrO ₃ (excess)	39.75	0.01406	0.0221	4.966	5.793 (N. & A.)
Thallium Nitrate TlNO ₃	25	0.0227	0.00852	6.04	2.233 (N.)
"	25	0.0822	0.00406	21.88	1.064
Potassium Thiocyanate, KSCN	25	0.0227	0.0083	2.208	2.176 (N.)

100 gms. Liquid Sulfur Dioxide dissolve 0.024 gm. TlSCN at 0°. (Jander and Ruppolt, 1937.)

THALLIUM CARBONATE Ti_2CO_3 .

SOLUBILITY IN WATER.

(Crookes, 1864; Lamy, 1863.)

t°.	15.5°.	18°.	62°.	100°.	100.8°.
Gms. Ti_2CO_3 per 100 gms. H_2O	4.2 (C.)	5.23	12.85	27.2 (C.)	22.4

100 gms. Liquid Sulfur Dioxide dissolve 0.01 gm. Ti_2CO_3 at 0°. (Jander and Ruppolt, 1937.)

Fusion-point data for $\text{Ti}_2\text{CO}_3 + \text{TiNO}_3$ are given by Brown, 1933.

THALLIUM OXALATE $\text{Ti}_2\text{C}_2\text{O}_4$.

One liter of saturated aqueous solution contains 15.77 gms. $\text{Ti}_2\text{C}_2\text{O}_4$ at 20°, and 18.69 gms. at 25°. (Böttger, 1903; Abegg and Spencer, 1905.)

SOLUBILITY OF THALLIUM OXALATE AT 25° IN AQ. SOLUTIONS OF:

COO

Thallium Nitrate. (Abegg and Spencer.)				Potassium Oxalate. (Abegg and Spencer.)			
Mol. Concentration.		Grams per Liter.		Mol. Concentration.		Grams per Liter.	
TiNO_3	$\text{Ti}_2\text{C}_2\text{O}_4$	TiNO_3	$\text{Ti}_2\text{C}_2\text{O}_4$	$\text{K}_2\text{C}_2\text{O}_4$	$\text{Ti}_2\text{C}_2\text{O}_4$	$\text{K}_2\text{C}_2\text{O}_4$	$\text{Ti}_2\text{C}_2\text{O}_4$
0.0	0.03768	0.00	18.69	0.0498	0.0351	8.281	17.42
0.04114	0.0264	10.95	13.10	0.0996	0.03565	16.57	17.69
0.0799	0.0195	21.26	9.68	0.2467	0.0390	41.02	19.36
0.1597	0.01235	42.51	6.128	0.4886	0.04506	81.25	22.37
				0.9785	0.05536	162.6	27.48

THALLIUM CHLORIDE TiCl .

SOLUBILITY IN WATER.

(Average curve from results of Noyes, 1892; Böttger, 1903; Kohlrausch, 1904; Hebbeling; Crookes; Lamy. The results of Berkeley, 1904 are also given.)

t°.	Gms. TiCl per Liter.		t°.	Gms. TiCl per Liter.		t°.	Gms. TiCl per Liter.	
0	2.1 (av.)	1.7 (B.)	25	3.86	4	60	8	10.2
10	2.5	2.4	30	4.2	4.6	80	12	16
20	3.3	3.4	40	5.2	6	100	18	24.1 (99.3°)
			50	6.3	8			

The results of Berkeley are in terms of gms. of TiCl per 1000 gms. H_2O but since the densities of the solutions are approximately 1 in all cases, except for temperatures above 60°, the differences are negligible. The Sp. Gr. of the sat. sol. at 99.3° is 0.9787 and the figure 24.1, therefore, becomes 23.58 gms. per liter.

One liter sat. solution in water contains 2.27 gms. TiCl at 9.54°, 3.05 gms. at 17.7°, and 3.97 gms. at 25.76°. (Kohlrausch, 1908.)

The more recent determinations of Osborg, 1926; Butler and Hiscocks, 1926; Randall and Chang, 1928; Benrath and Ammer, 1929; Failey, 1932, 1932a, 1933; were plotted and the following results taken from the average curve. The results of Jones and Schumb, 1921, by the electrolytic conductivity method are not in good agreement with the others. The results for temperatures above 100° are by Benrath, Gjedebø, Schiffers and Wunderlich, 1937.

t°	Gms. TiCl per liter sat. sol.	t°	Gms. TiCl per liter sat. sol.	t°	Gms. TiCl per liter sat. sol.
0	1.61	144	4.2	338	26.4
10	2.40	177	6.67	364	30 - 86
20	3.25	205	9.0	367	91.5
25	3.80	234	12.3	381	96.2
50	7.83	303	21.1	430 ^m .pt.	100.0

Cl

SOLUBILITY OF THALLI-THALLO CHLORIDES IN WATER AT 35°.

(Benrath, 1924.)

Gms. per 100 gms. H ₂ O		Solid Phase.	Gms. per 100 gms. H ₂ O		Solid Phase.
TlCl ₃ .	TlCl.		TlCl ₃ .	TlCl.	
0.0	0.051	TlCl (white)	74.401	0.770	[TlCl ₆] Tl ₃ (yellow)
0.169	0.373	[TlCl ₆] Tl ₃ (yellow)	88.510	1.021	"
0.823	0.265	"	118.875	1.536	"
2.173	0.237	"	144.782	2.272	"
2.872	0.232	"	157.161	2.695	"
3.566	0.216	"	160.502	2.917	"
4.444	0.236	"	163.291	2.887	[TlCl ₄] Tl (white)
8.723	0.237	"	166.434	2.826	"
15.097	0.272	"	172.971	2.779	"
28.109	0.244	"	197.997	2.653	"
39.940	0.314	"			

SOLUBILITY OF THALLI-THALLO CHLORIDES IN WATER AT SEVERAL TEMPERATURES.

(Benrath, 1924.)

Gms. per 100 gms. H ₂ O		Solid Phase.	Gms. per 100 gms. H ₂ O		Solid Phase.
TlCl ₃ .	TlCl.		TlCl ₃ .	TlCl.	
Results at 43°			40.512	0.698	[TlCl ₆] Tl ₃ (yellow)
0.0	0.070	TlCl (white)	88.845	1.995	"
0.214	0.496	[TlCl ₆] Tl ₃ (yellow)	120.601	3.006	"
1.875	0.405	"	155.838	5.412	"
4.954	0.356	"	157.413	5.587	"
20.184	0.426	"	163.985	6.215	"
39.561	0.495	"	167.913	6.669	"
65.597	0.803	"	177.163	6.687	[TlCl ₄] Tl (white)
90.693	1.187	"	183.968	6.612	"
117.654	1.976	"	201.022	6.578	"
144.840	3.115	"	214.579	6.493	"
156.167	3.771	"	Results at 70°		
166.853	4.424	"	178.31	10.356	[TlCl ₆] Tl ₃ (yellow)
171.000	4.400	[TlCl ₄] Tl (white)	187.16	10.580	[TlCl ₄] Tl (white)
195.820	4.361	"	Result at 80°		
209.542	4.302	"	179.82	15.291	[TlCl ₆] Tl ₃ (yellow)
Results at 55°			225.37	16.013	"
0.0	0.092	TlCl (white)	245.20	15.920	[TlCl ₄] Tl (white)
0.291	0.678	[TlCl ₆] Tl ₃ (yellow)	Results at 90°		
1.327	0.593	"	287.41	20.085	[TlCl ₆] Tl ₃ (yellow)
4.458	0.586	"	290.83	19.876	[TlCl ₄] Tl (white)
26.501	0.532	"			

SOLUBILITY OF THALLIUM CHLORIDE AT 25° IN AQUEOUS SOLUTIONS OF:

Acetic Acid.

(Hill, 1917.)

Nitric Acid.

(Hill and Simmons, 1909.)

Normality of Aq. CH_3COOH .	TlCl per Liter.		Normality of Aq. HNO_3 .	d_{25} of Sat. Sol.	TlCl per Liter.	
	Gms.	Gm. Equiv.			Gms.	Gm. Equiv.
0	3.8515	0.016085	0	0.996	3.951	0.0165
0.0501	3.8375	0.016027	0.4977	1.0184	5.937	2.475
0.0958	3.8326	0.016006	1.0046	1.0359	6.882	2.875
0.263	3.7503	0.015662	2.0452	1.0705	8.143	3.401
0.524	3.6539	0.015258	4.0170	1.1362	9.925	4.145

SOLUBILITY OF THALLIUM CHLORIDE IN AQUEOUS SOLUTIONS OF SALTS
WITH A COMMON ION AT 25°.

(Noyes, 1892.)

Aqueous Solution of:	Gms. Equiv. Added Salt per Liter.	Gms. Equiv. Dissolved TlCl per Liter.	Aqueous Solution of:	Gms. Equiv. Added Salt per Liter.	Gms. Equiv. Dissolved TlCl per Liter.
Water alone	0	0.01612	MgCl_2	0.025	0.00904
NH_4Cl	0.025	0.00877	"	0.050	0.00618
"	0.05	0.00593	"	0.10	0.00413
"	0.20	0.00271	"	0.20	0.00275
BaCl_2	0.05	0.00620	MnCl_2	0.025	0.00898
"	0.10	0.00425	"	0.05	0.00617
CdCl_2	0.025	0.01040	"	0.10	0.00412
"	0.05	0.00780	"	0.20	0.00286
"	0.10	0.00578	KCl	0.025	0.00872
"	0.20	0.00427	"	0.05	0.00593
CaCl_2	0.025	0.00899	"	0.10	0.00399
"	0.05	0.00624	"	0.20	0.00265
"	0.10	0.00417	"	0.80	0.00170
"	0.20	0.00284	NaCl	0.025	0.00860
CuCl_2	0.025	0.00905	"	0.05	0.00592
"	0.05	0.00614	"	0.10	0.00395
"	0.10	0.00422	"	0.20	0.00271
"	0.20	0.00291	TlClO_3	0.025	0.00897
HCl	0.025	0.00869	"	0.025	0.00894
"	0.05	0.00585	TlNO_3	0.025	0.00883
"	0.10	0.00384	"	0.05	0.00626
"	0.20	0.00254	"	0.10	0.00423

SOLUBILITY OF THALLIUM CHLORIDE IN AQUEOUS SALT SOLUTIONS AT 25°.
(Noyes, 1890; Noyes and Abbott, 1895; Geffcken, 1904.)

Aq. Salt Solution.	G. Mols. per Liter.		Gms. per Liter.	
	Salt.	TlCl.	Salt.	TlCl.
Ammonium Nitrate NH_4NO_3	0	0.01612	0	3.861 (G.)
"	0.5	0.02587	40.02	6.209
"	1	0.03121	80.05	7.473
"	2	0.03966	160.10	9.497
Barium Chloride BaCl_2	0.0283	0.00857	5.895	2.052 (N.)
"	0.1468	0.00323	30.59	0.773
Cadmium Sulfate CdSO_4	0.030	0.0206	6.255	4.933 (N.)
"	0.0787	0.0254	16.41	6.081
"	0.1574	0.0309	32.82	7.399
Hydrochloric Acid HCl	0.0283	0.00836	1.032	2.002 (N.)
"	0.0560	0.00565	2.043	1.353
"	0.1468	0.00316	5.357	0.757
Lithium Nitrate LiNO_3	0.5	0.02542	34.53	6.085 (G.)
"	1	0.03035	69.07	7.266
"	2	0.03785	138.14	9.063
"	3	0.04438	207.21	10.630
Potassium Chlorate KClO_3	0.5	0.0237	61.28	5.674 (G.)
Potassium Nitrate KNO_3	0.015	0.0170	1.517	4.070 (N.)
"	0.030	0.0179	3.033	4.286
"	0.0787	0.0192	7.775	4.597
"	0.1574	0.0212	15.920	5.076
"	0.5	0.0257	50.55	6.153 (G.)
"	1	0.0308	101.11	7.375
"	2	0.0390	202.22	9.340
Sodium Acetate CH_3COONa	0.015	0.0168	1.231	4.023 (N.)
"	0.030	0.0172	2.462	4.118
"	0.0787	0.0185	6.46	4.430
"	0.1574	0.0196	12.92	4.693
Sodium Nitrate NaNO_3	0.5	0.02564	42.50	6.139 (G.)
"	1	0.03054	85.01	7.313
"	2	0.03851	170.02	9.221
"	3	0.04544	255.03	10.88
"	4	0.05128	340.12	12.28
Sodium Chlorate NaClO_3	0.5	0.02320	53.25	5.555 (G.)
"	1	0.02687	106.5	6.433
"	2	0.03060	213	7.326
"	3	0.03303	319.5	7.909
"	4	0.03850	426	9.215
Thallium Bromate TlBrO_3 (at 39.75°)	0.01567	0.01959	5.201	4.690 (N. & A.)
Thallium Nitrate TlNO_3	0.0283	0.0083	7.518	1.987 (N.)
"	0.0560	0.00571	14.89	1.368
"	0.1468	0.00332	39.05	0.795
Thallium Sulfate Tl_2SO_4	0.0283	0.00886	14.27	2.121 (N.)
"	0.0560	0.00624	28.23	1.494
Thallium Thiocyanate TlSCN	0.0107	0.0119	2.802	2.849 (N.)
"	(at 39.75°)	0.02149	5.632	4.326 (N. & A.)

NOTE. — In the case of the results for thallium bromate and thallium thiocyanate at 39.75°, the solutions were saturated with respect to these salts as well as with respect to thallium chloride.

SOLUBILITY OF THALLOUS CHLORIDE IN AQUEOUS SOLUTIONS OF SALTS.

(Butler and Hiscocks, 1926.)

Constant agitation was employed and equilibrium was approached from above and from below. The thallium was determined by titration with standard permanganate except in cases where thallos salts were used in the solvent.

Salt.	Mols. salt. per liter.	$d \frac{t}{4}$ of sat. sol.	Mols. TlCl. per liter.	Salt.	Mols. salt. per liter.	$d \frac{t}{4}$ of sat. sol.	Mols. TlCl. per liter.
Results at 0°.							
None (= Water)		1.0014	0.00670	Tl ₂ SO ₄	0.025	1.0098	0.00680
KNO ₃	0.05	1.0039	0.00787	"	0.05	1.0186	0.00463
"	0.20	1.0155	0.00955	ZnSO ₄	0.05	1.0097	0.01801
"	0.50	1.0349	0.01184	"	0.10	1.0184	0.01836
"	1.00	1.0661	0.01472	"	0.30	1.0515	0.01913
ZnSO ₄	0.05	1.0105	0.00875	"	0.5994	1.0993	0.01937
"	0.10	1.0188	0.00979	La ₂ (SO ₄) ₃	0.01	1.0055	0.01801
"	0.30	1.0674	0.01214	"	0.015	1.0079	0.01836
"	0.5994	1.1015	0.01423	"	0.02	1.0098	0.01913
La ₂ (SO ₄) ₃	0.01	1.0063	0.00746	"	0.025	1.0122	0.01937
"	0.015	1.0088	0.00805	Results at 50°.			
"	0.02	1.0110	0.00828	None (= Water)	0.9950	0.03265	
"	0.025	1.0135	0.00845	KCl	0.05	0.9943	0.01835
Results at 25°.				"	0.10	0.9957	0.01281
None (= Water)		1.0004	0.01607	"	0.20	0.9996	0.00893
KCl	0.05	1.0003	0.00586	"	0.50	1.0121	0.00606
"	0.10	1.0033	0.00387	TlNO ₃	0.10	1.0131	0.01381
"	0.20	1.0063	0.00258	"	0.20	1.0321	0.01010
"	0.50	1.0203	0.00176	Tl ₂ SO ₄	0.025	1.0012	0.02061
TlNO ₃	0.05	1.0078	0.00615	"	0.05	1.0140	0.01567
"	0.10	1.0202	0.00413	KNO ₃	0.05	0.9989	0.03598
"	0.20	1.0399	0.00300	"	0.20	1.0088	0.04136
KNO ₃	0.05	1.0038	0.01826	"	0.50	1.0273	0.04794
"	0.20	1.0138	0.02151	"	1.00	1.0571	0.05524
"	0.50	1.0327	0.02556	ZnSO ₄	0.05	1.0046	0.04027
"	1.00	1.0619	0.03030	"	0.10	1.0249	0.04457
				"	0.30	1.0459	0.05349
				"	0.5994	1.0952	0.06163

Cl

THALLIUM CHLORIDE

SOLUBILITY OF THALLIUM CHLORIDE AT 25° IN AQUEOUS SOLUTIONS OF:

(Randall and Cheng, 1928.)

Magnesium Sulfate

Lanthanum Nitrate

Gm. Mols. per 1000 Gms. H ₂ O		Gm. Mols. per 1000 Gms. H ₂ O		Gm. Mols. per 1000 Gms. H ₂ O		Gm. Mols. per 1000 Gms. H ₂ O	
MgSO ₄ TlCl		MgSO ₄ TlCl		La(NO ₃) ₃ TlCl		La(NO ₃) ₃ TlCl	
0.000	0.01611	0.06259	0.02214	0.005215	0.01740	0.04180	0.02129
0.01708	0.01920	0.1291	0.02504	0.008808	0.01778	0.08166	0.02433
0.03364	0.02042	0.1994	0.02641	0.02024	0.01946	0.1970	0.02697
0.04384	0.02106	0.3529	0.03878				

Tl THALLIUM

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SOLUBILITY OF THALLIUM CHLORIDE IN AQUEOUS SOLUTIONS OF CADMIUM CHLORIDE AT 25°.

(Benrath and Ammer, 1929.)

Gms. per 100 gms. H ₂ O		Solid Phase	Gms. per 100 gms. H ₂ O		Solid Phase
TlCl	CdCl ₂		TlCl	CdCl ₂	
0.376	0.0	TlCl	0.033	52.96	TlCl.CdCl ₂
0.024	9.27	TlCl.CdCl ₂	0.034	76.16	"
0.016	19.27	"	0.041	93.70	"
0.019	23.60	"	0.043	99.25	"
0.023	37.59	"	0.052	125.02	"
			0.0	131.5	CdCl ₂

SOLUBILITY OF THALLIUM CHLORIDE AT 25° IN AQUEOUS SOLUTIONS OF:

(Benrath and Ammer, 1929.)

Barium Chloride		Calcium Chloride		Strontium Chloride	
Gms. per 100 gms. H ₂ O		Gms. per 100 gms. H ₂ O		Gms. per 100 gms. H ₂ O	
BaCl ₂	TlCl	CaCl ₂	TlCl	SrCl ₂	TlCl
2.0	0.070	5.0	0.040	5.0	0.042
5.0	0.043	18.5	0.060	10.0	0.040
10.0	0.041	28.3	0.109	20.0	0.045
18.0	0.044	41.28	0.154	30.0	0.062
25.0	0.044	45.30	0.203	40.0	0.074
30.0	0.063	67.77	0.488	50.0	0.098
36.32	0.086	88.67	0.875	53.4	0.134

The solid phase is TlCl in all cases.

SOLUBILITY OF THALLIUM CHLORIDE IN AQUEOUS SOLUTIONS OF MERCURIC CHLORIDE AT 25°.

(Benrath and Ammer, 1929.)

Gms. per 100 gms. H ₂ O		Solid Phase	Gms. per 100 gms. H ₂ O		Solid Phase
HgCl ₂	TlCl		HgCl ₂	TlCl	
0.037	0.289	TlCl	2.146	0.065	TlCl.HgCl ₂
0.072	0.270	"	3.748	0.059	"
0.291	0.144	"	4.691	0.057	"
1.303	0.091	TlCl.HgCl ₂	6.346	0.034	"
1.561	0.078	"	7.218	0.0	HgCl ₂

SOLUBILITY OF THALLIUM CHLORIDE IN AQUEOUS SOLUTIONS OF MAGNESIUM CHLORIDE AT 25°.

(Benrath and Ammer, 1929.)

Gms. per 100 gms. H ₂ O		Solid Phase	Gms. per 100 gms. H ₂ O		Solid Phase
MgCl ₂	TlCl		MgCl ₂	TlCl	
0.58	0.091	TlCl	30.0	0.076	TlCl
2.78	0.053	"	38.75	0.146	"
5.50	0.045	"	40.28	0.137	3TlCl.MgCl ₂
11.69	0.033	"	44.47	0.085	"
17.19	0.040	"	51.41	0.020	"
20.00	0.055	"	54.15	0.007	"

THALLIUM CHLORIDE

SOLUBILITY OF THALLIUM CHLORIDE IN AQUEOUS SOLUTIONS OF
ZINC CHLORIDE AT 25°.

(Benrath and Ammer, 1929.)

Gms. per 100 gms. H ₂ O		Solid Phase	Gms. per 100 gms. H ₂ O		Solid Phase
ZnCl ₂	TlCl		ZnCl ₂	TlCl	
0.0	0.376	TlCl	160.9	4.67	3TlCl·ZnCl ₂
1.11	0.04	"	163.7	5.49	2TlCl·ZnCl ₂
2.52	0.007	"	229.9	12.11	"
11.15	0.059	"	246.0	18.52	"
37.55	0.186	"	303.1	33.59	"
76.40	0.780	3TlCl·ZnCl ₂	323.7	42.31	"
92.47	0.950	"	332.7	49.31	"
126.00	1.97	"	354.4	30.00	"
138.1	2.49	"	367.3	22.97	"
145.8	3.75	"	390.4	0.0	ZnCl ₂

SOLUBILITY OF THALLIUM CHLORIDE IN AQUEOUS SOLUTIONS OF
ZINC SULFATE AT 25°.

(Lefter and Goldman, 1923.)

Gm. Mols. per liter		Gm. Mols. per liter	
ZnSO ₄	TlCl	ZnSO ₄	TlCl
0.05	0.02059	0.30	0.02770
0.10	0.02279	0.5994	0.03203

Cl

SOLUBILITY OF THALLIUM CHLORIDE IN AQUEOUS SOLUTIONS OF SALTS AT 25°
(Bray and Winninghoff, 1911.)

Solvent.			Saturated Solution.		
Salt Present.	Gms. Equiv. Salt per Liter.	d ₂₅ of Aq. Solvent.	Gms. Equiv. Salt per Liter.	d ₂₅ of Sat. Sol.	Gms. Equiv. TlCl per Liter.
None	...	...	...	0.9994	0.01607
KNO ₃	0.02001	0.9973	0.020	1.0009	0.01716
"	0.05000	0.9992	0.04997	1.0028	0.01826
"	0.10005	1.0023	0.09998	1.0063	0.01961
"	0.3002	1.0145	0.3000	1.0194	0.02313
"	1.0005	1.0568	0.9996	1.0632	0.03072
K ₂ SO ₄	0.01997	0.9975	0.01996	1.0012	0.01779
"	0.05000	0.9995	0.04996	1.0037	0.01942
"	0.1000	1.0030	0.09989	1.0074	0.02137
"	0.3000	1.0167	0.29966	1.0221	0.02600
"	1	1.0628	0.9986	1.0698	0.03416
Tl ₂ SO ₄	0.0200	1.0007	0.01999	1.0028	0.01034
"	0.0500	1.0076	0.04999	1.0090	0.006772
"	0.1000	1.0191	0.09997	1.0200	0.004679

One liter of water dissolves 2.7 gms. *thallo thallic chloride* 3TlCl·TlCl₃ at 15°-17°, and 35 gms. at 100°.

(Crookes, 1864; Lamy; Heberling.)

THALLIUM CHLORIDE

SOLUBILITY OF THALLIUM CHLORIDE IN AQUEOUS SOLUTIONS OF
AMINO ACIDS AT 25°.

(Falley, 1935.)

Aq. Solvent		Gm. Mol. TlCl per liter	Aq. solvent		Gm. Mol. TlCl per liter
Amino Acid	Gm. Mols. per liter		Amino Acid	Gm. Mols. per liter	
Glycylglycine	0.2	0.01835	α Amino n Butyric Ac.	0.1	0.01648
Glycine	0.2	0.01725	" " " "	0.2	0.01688
α Alanine	0.2	0.01703	" " iso " "	0.2	0.01679
Urea	0.2	0.01642	" " n Valeric " "	0.1	0.01627
Diketo piperazine	0.1	0.01602	" " " "	0.2	0.01633

SOLUBILITY OF THALLIUM CHLORIDE IN AQUEOUS SOLUTIONS OF
GLYCINE ALONE AND IN PRESENCE OF ACID AND BASE AT 25°.

(Falley, 1932.)

Gm. Mols. per 1000 gms. H ₂ O		Gm. Mols. TlCl per 1000 gms. H ₂ O	Gm. Mols. per 1000 gms. H ₂ O		Gm. Mols. TlCl per 1000 gms. H ₂ O
Glycine	HNO ₃ or NaOH		Glycine	HNO ₃ or NaOH	
0.00	—	0.01617	0.10	0.025 NaOH	0.01810
0.010	—	0.01623	0.10	0.050 "	0.01902
0.030	—	0.01634	0.10	0.075 "	0.01978
0.050	—	0.01648	0.10	0.100 "	0.02051
0.100	—	0.01678	—	0.025 HNO ₃	0.01734
0.200	—	0.01745	—	0.050 "	0.01821
0.10	0.025 HNO ₃	0.01794	—	0.075 "	0.01887
0.10	0.050 "	0.01868	—	0.100 "	0.01945
0.10	0.075 "	0.01925	—	0.025 NaOH	0.01777
0.10	0.100 "	0.01979	—	0.050 "	0.01896
			—	0.075 "	0.01995
			—	0.100 "	0.02086

SOLUBILITY OF THALLIUM CHLORIDE IN AQUEOUS SOLUTIONS
OF EDESTIN NITRATE AT 25°.

(Falley, 1932a.)

Per 1000 gms. H ₂ O of sat. sol.			Per 1000 gms. H ₂ O of sat. sol.		
Gms. Edestin	Gm. Mol. HNO ₃	Gm. Mol. TlCl	Gms. Edestin	Gm. Mol. HNO ₃	Gm. Mol. TlCl
0.0	0.025	0.01734	0.0	0.050	0.01821
4.5	0.025	0.01763	5.2	0.050	0.01842
13.4	0.025	0.01802	10.1	0.050	0.01861
13.8	0.025	0.01827	24.2	0.050	0.01953
30.1	0.025	0.01924	28.1	0.050	0.01971
34.7	0.025	0.01948	45.9	0.050	0.02131
48.8	0.025	0.02043			

100 gms. Methyl Alcohol (CH₃OH) dissolve 0.000029 gm. equiv. TlCl at 25°. (Buckley and Hartley, 1929.)

100 gms. Liquid Sulfur Dioxide (SO₂) dissolve 0.007 gm. TlCl at 0°. (Jander and Ruppolt, 1937.)

SOLUBILITY IN WATER.

(Muir, 1876.)

t°.	0°.	20°.	50°.	80°.	100°.
Gms. TiClO_3 per 100 gms. H_2O	2	3.92	12.67	36.65	57.31

One liter sat. aq. solution contains 38.51 gms. TiClO_3 at 20°. (Noyes and Farrel; 1911.)

One liter of aqueous solution, saturated with both salts, contains 30.4 gms. TiClO_3 + 34.43 gms. Ti_2SO_4 at 20°. (Noyes and Farrel, 1911.)

SOLUBILITY OF MIXED CRYSTALS OF THALLIUM CHLORATE AND POTASSIUM CHLORATE IN WATER AT 10°.

(Roozeboom, 1891.)

NOTE. — Solutions of the two salts were mixed in different proportions and allowed to crystallize, such amounts being taken that not more than one or two grams would separate from one liter.

Gms. per 1000 cc. Solution.		Mg. Mols. per 1000 cc. Solution.		Sp. Gr. of Solutions.	Mols. per cent KClO_3 in Mixed Crystals.	
TiClO_3 .	KClO_3 .	TiClO_3 .	KClO_3 .			
25.637	...	89.14	...	1.0210	0	
19.637	6.884	68.27	56.15	1.0222	2	
12.001	26.100	41.73	212.89	1.0278	12.61	
9.036	40.064	31.42	326.79	1.0338	25.01	
7.885	46.497	27.42	379.26	1.0359	36.30-97.93	ClO
7.935	46.535	27.60	379.57	1.0360		
6.706	46.410	23.32	378.55	1.0357	99.28	
6.723	47.109	23.37	384.25	1.0363	99.60	
4.858	47.312	16.89	385.91	1.0345	99.62	
2.769	47.134	9.63	384.46	1.0330	99.67	
...	49.925	...	407.22	1.0330	100	

SOLUBILITY OF MIXED CRYSTALS OF THALLIUM CHLORATE AND POTASSIUM CHLORATE IN WATER AT DIFFERENT TEMPERATURES.

(Quoted by Rabe, 1902.)

- 100 gms. H_2O dissolve 2.8 gms. TiClO_3 + 3.3 gms. KClO_3 at 0°.
 " H_2O dissolve 10 gms. TiClO_3 + 1.5 gms. KClO_3 at 15°.
 " H_2O dissolve 12.67 gms. TiClO_3 + 16.2 gms. KClO_3 at 50°.
 " H_2O dissolve 57.3 gms. TiClO_3 + 48.2 gms. KClO_3 at 100°.

THALLIUM PerCHLORATE TiClO_4 .

SOLUBILITY IN WATER.

(Carlson, 1910.)

t°.	Sp. Gr. Sat. Sol.	Gms. TiClO_4 per 100 Gms. H_2O .	t°.	Sp. Gr. Sat. Sol.	Gms. TiClO_4 per 100 Gms. H_2O .
0	1.060	6	50	1.251	39.62
10	1.075	8.04	70	1.430	65.32
30	1.146	19.72	80	1.520	81.49

100 gms. H_2O dissolve 10 gms. TiClO_4 at 15° and 166.6 gms. at 100°.

(Roscoe, 1866.)

100 gms. Liquid Sulfur Dioxide (SO_2) dissolve 0.013 gm. TiClO_4 at 0°.
 (Jander and Ruppolt, 1937.)

THALLIUM CHROMATE Ti_2CrO_4 .

100 gms. H_2O dissolve 0.03 gm. Ti_2CrO_4 at 60° , and 0.2 gm. at 100° .

One liter of aq. 31 per cent KOH solution dissolves 18 gms. Ti_2CrO_4 .
(Browning and Hutchins, 1900.)

One liter of H_2O dissolves 0.35 gm. thallium trichromate, $\text{Ti}_2\text{Cr}_3\text{O}_{10}$, at 15° ,
and 2.27 gms. at 100° .
(Lepierre and Lachand, 1891.)
(Crookes, 1864.)

SOLUBILITY OF THALLIUM CHROMATE IN WATER AND IN AQUEOUS SOLUTIONS AT 20° .

(Moser and Brukl, 1926.)

Constant agitation was employed for securing saturation.

Cro

Solvent.	Gms. Ti_2CrO_4 per liter sat. sol.	Solvent.	Gms. Ti_2CrO_4 per liter sat. sol.
Water	0.0427	Aq. 2 % $\text{NH}_3 + 1$ % K_2CrO_4	0.0100
Aq. 60 % Ethyl Alcohol.	0.0092	» » » + 2 % »	0.0095
» 70 % » »	0.0080	» 5 % » + » »	0.0142
» 80 % » »	0.0072	» 10 % » + » »	0.0205
» 96 % » »	0.0060	» 2 % » + 4 % » + 10 % Alcohol	0.0060

THALLIUM FLUORIDE TlF .

100 gms. H_2O dissolve 80 gms. TlF at 15° .

(Büchner, 1865.)

THALLIUM IODIDE TlI

One liter sat. solution in water contains 0.0362 gm. at 9.9° , 0.056 gm. at 18.1°
and 0.0847 gm. at 26° .
(Kohlrausch, 1908.)

SOLUBILITY OF THALLIUM IODIDE IN WATER.

(Average results from Büttger, 1903; Kohlrausch, 1904-05; Werther; Crookes, 1864; Lamy; Hebbingling.)

I

t° .	0° .	20° .	40° .	60° .	80° .	100° .
Gms. TlI per liter	0.02	0.06	0.15	0.35	0.70	1.20

One liter of $2\frac{1}{2}$ per cent aq. ammonia dissolves 0.761 gm. TlCl .

One liter of $6\frac{1}{2}$ per cent aq. ammonia dissolves 0.758 gm. TlCl .

One liter of 90 per cent alcohol dissolves 0.0038 gm. TlCl .

One liter of 50 per cent alcohol dissolves 0.027 gm. TlCl .
(Long, 1888.)

Data for the temperatures of solidification of mixtures of TlI and TlNO_3 are given by Van Eyk (1901).

1000 cc. sat. solution of thallous iodide in water contain 0.0000587 gm. mol. TlI at 0° and 0.000235 gm. mol. at 25° . The determinations were made by the electrolytic conductivity method.
(Jones and Schumb, 1921.)

Similar determinations by Davies and Robinson, 1937, gave 6.47×10^{-8} as the solubility product and 0.000254 gm. mols. (= 0.084 gms. LiI) per liter at 25° as the solubility of LiI in water.

100 gms. Liquid Sulfur Dioxide (SO_2) dissolve 0.06 gm. TlI at 0° .
(Jander and Ruppolt, 1937.)

IO

THALLIUM IODATE TlIO_3 .

One liter aq. solution contains 0.578 gm. TlIO_3 at 20° .
(Böttger, 1903.)

One liter aqueous solution contains $1.76 \cdot 10^{-4}$ mols. TlIO_3 at $25^\circ = 0.667$ gm.,
determined by means of electrodes of the third kind.
(Spencer, 1912.)

SOLUBILITY OF THALLIUM IODATE IN AQUEOUS SALT SOLUTIONS AT 25°.
(LaMer and Goldman, 1929.)

Concentration of Aq. salt sol. in Gm. Mols. per liter	Gm. Mols. TlIO ₃ per liter sat. sol.	Concentration of Aq. salt sol. in Gm. Mols. per liter	Gm. Mols. TlIO ₃ per liter sat. sol.
H ₂ O alone	0.001819 (1)	0.01 NaNO ₃	0.002486
0.001 K ₂ SO ₄	0.001912	0.0333 Na ₂ SO ₄	0.002543
0.002 " "	0.001958	0.05 " "	0.002740
0.005 " "	0.002075	0.005 MgSO	0.002068
0.010 " "	0.002193	0.01 " "	0.002172
0.013 " "	0.002252	0.025 " "	0.002387
0.030 " "	0.002513	0.05 " "	0.002640
0.0333 " "	0.002544	0.05 " "	0.002635 (1)
0.05 " "	0.002747	0.01 KCl	0.002005
0.064 " "	0.002877	0.02 " "	0.002107
0.15 " "	0.003520	0.05 " "	0.002335
0.25 " "	0.004028	0.10 " "	0.002625
0.50 " "	0.005128	0.0333 MgCl ₂	0.002544
0.01 KNO ₃	0.001987	0.05 " "	0.002744
0.02 " "	0.002079	0.05 " "	0.002755 (1)
0.05 " "	0.002270	0.10 NaCl	0.002620
0.10 " "	0.002492	0.0333 Mg(NO ₃) ₂	0.002459
0.30 " "	0.003126	0.05 " "	0.002621
0.50 " "	0.003673	0.05 ZnSO ₄	0.002789
1.00 " "	0.004821	0.05 CdSO ₄	0.002798 (1)
		0.05 CdCl ₂	0.002708 (1)

IO

(1) Results in a later paper by Friedman and LaMer, 1931.

SOLUBILITY OF THALLIUM IODATE IN AQUEOUS SOLUTIONS OF
AMINO ACIDS AT 25°.
(Failey, 1933.)

Conc. of Aq. Amino Acid Sol. in Gm. Mols. per liter	Gm. Mols. TlIO ₃ per liter sat. sol.	Conc. of Aq. Amino Acid Sol. in Gm. Mols. per liter	Gm. Mols. TlIO ₃ per liter sat. sol.
H ₂ O alone	0.001843	0.20 Sarcosine	0.001993
0.20 Glycylglycine	0.002282	0.10 α Amino n Butyric Ac.	0.001966
0.025 Glycine	0.001875	0.2 " "	0.001971
0.05 " "	0.001907	0.025 Di methyl Glycine	0.001859
0.10 " "	0.001917	0.05 " " "	0.001873
0.15 " "	0.002033	0.10 " " "	0.001901
0.20 " "	0.002098	0.20 " " "	0.001957
0.025 α Alanine	0.001872	0.05 α Amino iso Butyric Ac.	0.001874
0.05 " "	0.001907	0.10 " " " "	0.001901
0.10 " "	0.001963	0.15 " " " "	0.001934
0.20 " "	0.002084	0.20 " " " "	0.001956
0.025 β Alanine	0.001863	0.10 α Amino n Valeric Ac	0.001895
0.05 " "	0.001884	0.20 " " " "	0.001939
0.10 " "	0.001919	0.025 Urea	0.001845
0.15 " "	0.001964	0.05 " "	0.001851
0.20 " "	0.002001	0.10 " "	0.001861
0.05 Sarcosine	0.001880	0.15 " "	0.001876
0.10 " "	0.001917	0.20 " "	0.001891
0.15 " "	0.001954	0.10 Diketopiperzine	0.001844

SOLUBILITY OF THALLIUM IODATE IN AQUEOUS SOLUTIONS OF SODIUM SALTS AT 25°.

(Palley, 1933a.)

Conc. of aq. salt sol. in Gm. Mols. per liter	Gm. Mols. TlIO_3 per liter sat. sol.	Conc. of aq. salt sol. in Gm. Mols. per liter	Gm. Mols. TlIO_3 per liter sat. sol.
H_2O alone	0.001843	0.005 $\text{Na}_2\text{C}_{12}\text{O}_{12}$	0.004980
0.0001 $\text{Na}_2\text{C}_{12}\text{O}_{12}$ (1)	0.001967	0.01	0.006184
0.0002	0.002092	0.02 NaCl	0.002118
0.0005 "	0.002426	0.04 "	0.002277
0.001 "	0.002901	0.10 "	0.002629
0.002 "	0.003636	0.01 NaOH	0.002003

(1) Sodium Mellitate.

The author also gives results at 25° for the solubility of Thallium Iodate in aq. 0.001 and 0.02 normal solutions of Sodium Mellitate to which various amounts of a third salt have been added.

SOLUBILITY OF THALLIUM IODATE IN AQUEOUS SOLUTIONS OF ETHYL ALCOHOL AT 25°.

(La Mer and Goldman, 1931.)

d. of sat. sol.	Wt. % $\text{C}_2\text{H}_5\text{OH}$ in aq. solvent	Gm. Mol. TlIO_3 per liter sat.	d. of sat. sol.	Wt. % $\text{C}_2\text{H}_5\text{OH}$ in aq. solvent	Gm. Mol. TlIO_3 per liter sat.
0.99718	0.0	0.001841	0.9478	31.61	0.000297
0.9894	4.25	0.001416	0.9304	40.51	0.000135
0.9780	11.56	0.000915	0.9167	46.91	0.00083
0.9644	21.37	0.000504	—	94.71	trace

THALLIUM NITRIDE TlN_3 .

SOLUBILITY OF THALLIUM NITRIDE IN WATER.

(Curtius and Rissom, 1898.)

t°	Gm. TlN_3 per 100 gms. sat. sol.	Solid Phase
0	0.171	TlN_3
5	0.196	"
16	0.30	"

THALLIUM NITRITE TlNO_2 .

SOLUBILITY OF THALLIUM NITRITE IN WATER.

(Ferrari and Colla, 1937.)

t°	d. of sat. sol.	Gms. TlNO_2 per 100 gms. sat. sol.	t°	d. of sat. sol.	Gms. TlNO_2 per 100 gms. sat. sol.
0	1.1471	15.15	50	1.8041	55.10
5	1.1811	18.43	55	1.9611	61.60
10	1.2383	22.44	60	2.2600	68.40
15	1.2627	25.30	65	2.7080	77.50
20	1.2942	28.75	71	—	86.19
25	1.3601	32.10	78	—	91.49
30	1.4193	34.73	89	—	94.45
35	1.5061	39.95	98	—	95.78
40	1.5771	45.53	110	—	97.42
45	1.6751	49.85	182m.pt.	—	100.00

THALLIUM NITRATE TlNO_3 .**SOLUBILITY IN WATER.**

(Berkeley, 1904; see also Etard, 1894; Crookes; Lamy.)

t°.	Gms. TlNO_3 per 100 Gms.		t°.	Gms. TlNO_3 per 100 Gms.	
	Solution.	Water.		Solution.	Water.
0	3.76	3.91	60	31.55	46.2
10	5.86	6.22	70	41.01	69.5
20	8.72	9.55	80	52.6	111.0
30	12.51	14.3	90	66.66	200.0
40	17.33	20.9	100	80.54	414.0
50	23.33	30.4	105	85.59	594.0

Solid phase. TlNO_3 rhombic.100 gms. H_2O dissolve 43.5 gms. TlNO_3 + 104.2 gms. KNO_3 at 58°. (Rabe, 1902.)

The freezing-point curve for the system thallium nitrate + thallium nitrate shows that a continuous series of mixed crystals is formed. (Cuttica, 1902.)

THALLIUM HYDROXIDE TlOH .**SOLUBILITY IN WATER.**

(Bahr, 1911.)

t°.	d_{20}^4 of Sat. Sol.	Mols. TlOH per Liter.	Gms. TlOH per Liter.	t°.	Mols. TlOH per Liter.	Gms. TlOH per Liter.
0	1.231	1.151	254.4	44.5	2.442	539.8
18.5	1.317	1.554	343.4	54.1	2.940	649.7
29	1.342	1.803	398.5	64.6	3.601	795.8
32.1	1.377	1.861	411.2	78.5	4.673	1033
36	1.417	2.075	458.6	90	5.705	1261
40	1.446	2.240	495	99.2	6.708	1483

The solutions were stirred by means of a current of hydrogen. The solid phase is the same at all temperatures.

THALLIUM HYDROXIDE (ic) Tl(OH)_3 .
**SOLUBILITY OF THALLIC HYDROXIDE IN AQUEOUS SOLUTIONS
OF PERCHLORIC ACID AND OF SULFURIC ACID AT 25°.**

(Sherrill and Haas, 1936.)

Results for Aq. Perchloric Acid**Results for Aq. Sulfuric Acid**

Wt. formality per liter	
HClO_4	Tl(OH)_3
0.5246	0.00221
0.9912	0.01485
1.4943	0.04424
1.9297	0.08881

Wt. formality per liter	
H_2SO_4	Tl(OH)_3
0.1590	0.001255
0.2084	0.002753
0.2871	0.006880
0.4676	0.02402
0.5267	0.03294
0.6215	0.05038

Fusion-point data for $\text{Tl}_2\text{O} + \text{V}_2\text{O}_5$ are given by Cannery, 1928.)

Tl THALLIUM

1556

THALLIUM Hypo PHOSPHITE TlH_2PO_2 .

SOLUBILITY OF THALLIUM HYPO PHOSPHITE IN WATER.

(Ferrari and Colla, 1937.)

t°	Gms. TlH_2PO_2 per 100 gms. sat. sol.	Solid Phase	t°	d. of sat. sol.	Gms. TlH_2PO_2 per 100 gms. sat. sol.	Solid Phase
- 7	43.68	Ice	0	2.538	77.69	TlH_2PO_4
-12	56.91		10	2.688	79.90	"
-17	63.63	"	20	2.827	81.53	"
-25 Eutec.	—	" + TlH_2PO_2	25	2.900	83.80	"
-23	70.93	TlH_2PO_2	35	3.049	86.32	"
-17	72.37	"	50	3.260	90.64	"
- 9.5	74.42	"	65	—	93.28	"
- 6.0	75.51	"	77	—	95.74	"
			100	—	98.62	"
			110m.pt.	—	100.00	"

PO

THALLIUM PHOSPHATE (ortho) Tl_3PO_4 .

One liter of sat. aqueous solution contains 4.97 gms. Tl_3PO_4 at 15° and 6.71 gms. at 100°. (Crookes, 1864.)

THALLIUM Per RHENATE $TlReO_4$.

SOLUBILITY OF THALLIUM PER RHENATE IN WATER.

(Noddack and Noddack, 1931.)

t°	Gms. $TlReO_4$ per liter sat. sol.	Solid Phase	t°	Gms. $TlReO_4$ per liter sat. sol.	Solid Phase
20.3	1.6	$TlReO_4$	42	5.8	$TlReO_4$
21.5	1.7		93	15.4	"
24.8	2.1				

THALLIUM SULFIDE Tl_2S .

S

One liter of sat. aqueous solution contains 0.215 gm. Tl_2S at 20°. (Böttger, 1903.)

The results of Moser and Behr, 1924, and of Bruner and Zawadski, 1909, 1910, upon the solubility of Thallous Sulfide in Water are critically reviewed and recalculated by Kolthoff, 1931, and by Ravitz, 1936, in connection with similar results upon other methal sulfides.

A diagram and discussion of the fusion points of $Tl_2S + S$, $Tl_2S + Se$ and $Tl_2S + Te$ are given by Pelabon, 1907.

1000 cc. aq. 0.01 normal H_2SO_4 , saturated with H_2S at 1 atmosphere pressure, dissolve 1.451 gms. Tl_2S at 20°. (Moser and Behr, 1924.)

THALLIUM SULFITE Tl_2SO_3 .

SO

100 gms. H_2O dissolve 3.34 gms. Tl_2SO_3 at 15.5°. (Seubert and Elten, 1892.)

100 gms. Liquid Sulfur Dioxide (SO_2) dissolve 0.242 gm. Tl_2SO_3 at 0°. (Jander and Ruppolt, 1937.)

THALLIUM SULFATE Ti_2SO_4 .**SOLUBILITY IN WATER.**

(Berkeley, 1904; see also Crookes; Lamy.)

t°.	Gms. Ti_2SO_4 per 100 Gms.		t°.	Gms. Ti_2SO_4 per 100 Gms.	
	Solution.	Water.		Solution.	Water.
0	2.63	2.70	60	9.89	10.92
10	3.57	3.70	70	11.31	12.74
20	4.64	4.87	80	12.77	14.61
30	5.80	6.16	90	14.19	16.53
50	8.44	9.21	99.7	15.57	18.45

100 gms. H_2O dissolve 3.36 gms. Ti_2SO_4 at 6.5°, 4.3 gms. at 12° and 19.14 gms. at 100°.

One liter sat. solution in water contains 48.59 gms. Ti_2SO_4 at 20° (Noyes and Farrel, 1911) and 54.59 gms. at 25° (Noyes and Stewart, 1911).

100 gms. H_2O simultaneously sat. with both salts dissolve:

4.74 gms. Ti_2SO_4 + 10.3 gms. K_2SO_4 at 15°.

11.5 " " + 16.4 " " 62°.

18.52 " " + 26.2 " " 100°.

(Rabe, 1902.)

The following results for the solubility of Thallium Sulfate in Water at temperatures above 100° are by Benrath, Gjedebø, Schiffers and Wunderlich, 1937.

t°	Gms. Ti_2SO_4 per 100 gms. sat. sol.	t°	Gms. Ti_2SO_4 per 100 gms. sat. sol.	t°	Gms. Ti_2SO_4 per 100 gms. sat. sol.
116	17.7	173	25.5	271	34.4
130	18.8	188	27.0	359	37.76
146	21.5	208	29.0	365	78.8
153	22.4	225	31.2	380	85.7
167	28.3	241	32.4	632m.pt.	100.0

SO

SOLUBILITY OF THALLIUM SULFATE IN WATER. (Cohen, de Meester and Moesveld, 1924).

The authors used a specially designed apparatus and observed all precautions necessary for determinations of the highest accuracy.

t°.....	30.0.	49.9.	60.0.
Gms. Ti_2SO_4 per 100 gms. sat. sol.	5.83	8.43	9.79

SOLUBILITY OF THALLIUM SULFATE IN WATER AT 30° AND UNDER HIGH PRESSURES. (Cohen, Voller and Moesveld, 1923.)

Pressure in atmospheres.....	1	500	1000	1500
Gms. Ti_2SO_4 per 100 gms. sat. sol.	5.83	7.48	9.03	10.50

SOLUBILITY OF THALLIUM OXIDE (Ti_2O_3) IN AQUEOUS SOLUTIONS OF SULFURIC ACID AT 25°. (Meyer, 1923; Meyer and Wilk, 1924.)

Constant agitation in a thermostat was employed.

Per cent H_2SO_4 .	Gms. per 100 cc. Aq. Sulfuric Acid		
	Ti_2O_3 .	$\text{Ti}(\text{OH})\text{SO}_4 \cdot 2\text{H}_2\text{O}$.	$\text{HTl}(\text{SO}_4)_{1/2} \cdot 4\text{H}_2\text{O}$.
20.....	16.2	25.2	—
40.....	9.8	15.2	—
50.....	2.52	—	2.9
70.....	0.30	—	0.61

The diagram given by the authors contains three branches, corresponding respectively to the solubility of Ti_2O_3 in dilute sulfuric acid and of the two sulfates, $\text{Ti}(\text{OH})\text{SO}_4 \cdot 2\text{H}_2\text{O}$ and $\text{HTl}(\text{SO}_4)_{1/2} \cdot 4\text{H}_2\text{O}$, in stronger acid. The existence of the basic salt $\text{Ti}(\text{OH})\text{SO}_4 \cdot 2\text{H}_2\text{O}$ requires a concentration of at least 10 % H_2SO_4 . The space diagram but not the numerical data is given for determinations at temperatures between 20° and 95°.

SOLUBILITY OF THALLIUM SULFATE IN AQUEOUS SOLUTIONS AT 25°.

(Noyes and Stewart, 1911.)

Solvent.		Saturated Solution.				
Salt Present.	Formula Wts. Salt per Liter.	Formula Wts. Salt per Liter.	Formula Wts. Tl_2SO_4 per Liter.	d_{25} of Sat. Sol.	Gms. Salt per Liter.	Gms. Tl_2SO_4 per Liter.
TlNO_3	0.099±	0.0996	0.08365	...	26.51	42.17
Na_2SO_4	0.04995	0.0497	0.1080	1.0531	7.062	54.44
"	0.20	0.1988	0.1173	1.0754	28.25	59.13
NaHSO_4	0.1015	0.1010	0.1161	1.0596	12.12	58.53
H_2SO_4	0.04967	0.0494	0.1172	1.0540	4.878	59.09
"	0.09933	0.0987	0.1249	1.0604	9.747	62.95

SOLUBILITY OF THALLIUM SULFATE IN AQUEOUS SOLUTIONS OF SULFURIC ACID AT 25°.

(D'Ans and Fritsche, 1909.)

Mols. per 1000 Gms. Sat. Sol.		Solid Phase.	Mols. per 1000 Gms. Sat. Sol.		Solid Phase.
H_2SO_4 .	Tl_2SO_4 .		H_2SO_4 .	Tl_2SO_4 .	
0	0.103	Tl_2SO_4	4.89	0.59	TiHSO_4
2.99	0.46	" + $\text{Tl}_2\text{H}(\text{SO}_4)_2$	4.92	0.66	"
4.25	0.61	$\text{Tl}_2\text{H}(\text{SO}_4)_2 + \text{TiHSO}_4$	4.78	0.75	"
4.55	0.56	TiHSO_4	4.26	1.01	"
4.79	0.55	"	4.03	1.08	"

SO

EQUILIBRIUM IN THE SYSTEM THALLIUM SULFATE, ZINC SULFATE AND WATER.

(Benrath, 1931.)

t°	Gms. per 100		Solid Phase	t°	Gms. per 100		Solid Phase
	gms. sat. sol.				gms. sat. sol.		
	TlSO_4	ZnSO_4			TlSO_4	ZnSO_4	
0	0.81	26.81	$\text{ZnSO}_4 \cdot 7\text{H}_2\text{O} + 1.1.6$	64.5	2.93	41.07	$\text{ZnSO}_4 \cdot \text{H}_2\text{O}$
"	2.74	0.97	$\text{Tl}_2\text{SO}_4 +$	"	5.66	40.04	" + 1.1.6
17.6	1.37	34.69	$\text{ZnSO}_4 \cdot 7\text{H}_2\text{O} +$	"	6.35	38.30	1.1.6
"	1.73	26.36	1.1.6	"	8.57	34.45	"
"	4.68	2.04	" + Tl_2SO_4	"	10.85	21.39	"
40.5	2.32	39.58	$\text{ZnSO}_4 \cdot 6\text{H}_2\text{O} + 1.1.6$	"	14.71	10.43	" + Tl_2SO_4
"	2.64	37.16	1.1.6	"	13.95	8.77	Tl_2SO_4
"	3.2	33.6	"	100	3.55	37.10	$\text{ZnSO}_4 \cdot \text{H}_2\text{O}$
"	3.91	28.2	"	"	11.97	34.58	" + 1.1.6
"	4.39	22.66	"	"	24.5	31.3	$\text{Tl}_2\text{SO}_4 +$
"	6.12	9.97	"	"	23.7	12.11	Tl_2SO_4
"	6.82	7.30	"				
"	8.34	4.48	" + Tl_2SO_4	1.1.6 =	$\text{Tl}_2\text{SO}_4 \cdot \text{ZnSO}_4 \cdot 6\text{H}_2\text{O}$.		

100 gms. Liquid Sulfur Dioxide (SO_2) dissolve 0.021 gm. Tl_2SO_4 at 0°.
(Jander and Ruppolt, 1937.)

THALLIUM DOUBLE SULFATES

SOLUBILITY IN WATER AT 25°.

(Locke, 1901.)

Double Sulfate.	Formula.	Salt per 100 cc. H_2O .	
		Gms. Anhydrous.	Gms. Mols.
Tl Copper Sulfate	$\text{Tl}_2\text{Cu}(\text{SO}_4)_2 \cdot 6\text{H}_2\text{O}$	8.1	0.0122
Tl Nickel Sulfate	$\text{Tl}_2\text{Ni}(\text{SO}_4)_2 \cdot 6\text{H}_2\text{O}$	4.61	0.007
Tl Zinc Sulfate	$\text{Tl}_2\text{Zn}(\text{SO}_4)_2 \cdot 6\text{H}_2\text{O}$	8.6	0.0129

THALLIUM ALUMS

SOLUBILITY IN WATER AT 25°.
(Locke, 1901.)

Alum.	Formula.	Salt per 100 Grams H ₂ O.		
		Gms. Anhydrous.	Gms. Hydrated.	Gm. Mols.
Tl Aluminum Alum	TlAl(SO ₄) ₂ ·12H ₂ O	7.5	11.78	0.0177
Tl Vanadium Alum	TlV(SO ₄) ₂ ·12H ₂ O	25.6	43.31	0.0573
Tl Chromium Alum	TlCr(SO ₄) ₂ ·12H ₂ O	10.48	16.38	0.0212
Tl Iron Alum	TlFe(SO ₄) ₂ ·12H ₂ O	36.15	64.6	0.0799

THALLI-THALLO SULFATE Tl₂SO₄·Tl₂(SO₄)₃.

SOLUBILITY OF THALLI-THALLO SULFATE IN AQUEOUS 16.36 PER CENT SULFURIC ACID.
(Benrath and Espenschied, 1922.)

t°.	Gms. Tl ₂ SO ₄ ·Tl ₂ (SO ₄) ₃ per 100 gms. sat. sol.	t°.	Gms. Tl ₂ SO ₄ ·Tl ₂ (SO ₄) ₃ per 100 gms. sat. sol.
48.5.....	17.26	61.0.....	16.89
55.2.....	16.69	65.5.....	16.23
60.5.....	16.89	83.5.....	15.35

The density of the aqueous H₂SO₄ was 1.115. Below 48° the ratio of Tl (I) and Tl (3) in the solution is no longer 1:1 as required for the double salt.

THALLIUM SELENATE Tl₂SeO₄.

SOLUBILITY IN WATER.

t°.	Gms. Tl ₂ SeO ₄ per 100 Gms. H ₂ O.	Authority.
9.3	2.13	(Tutton, 1907.)
12	2.4	"
20	2.8	(Glauser, 1910.)
80	8.5	"
100	10.86	(Tutton, 1907.)

SeO

THALLIUM SELENATES TlH(SeO₄)₂·2H₂O and Tl(OH)SeO₄·H₂O.

The system Tl₂O₃ + SeO₃ + H₂O at 25° is described by Meyer and Wilk, 1924, but numerical data are not given. It is stated that the curve is almost identical with that of selenium sulfate but the transition point is at 45 % H₂SeO₄ instead of at 40 %.

THALLIUM VANADATES.

SOLUBILITY IN WATER. (Carnelly, 1873; Liebig, 1860.)

Vanadate.	Formula.	Gms. Vanadate per 100 Gms. H ₂ O.	
		At 15°.	At 100°.
Tl. meta vanadate	TlVO ₃	0.087 (11°)	0.21
" ortho vanadate	Tl ₂ VO ₃	1	1.74
" pyro vanadate	Tl ₄ V ₂ O ₇	0.20 (14°)	0.26
" vanadate	Tl ₁₂ V ₃ O ₂₈	0.107	0.29

THULIUM OXALATE Tm₂(C₂O₄)₃·9H₂O(?·10H₂O).

100 cc. aq. 20% methylamine oxalate dissolve approx. 4.082 gms. thulium oxalate.

100 cc. aq. 20% ethylamine oxalate dissolve approx. 5.728 gms. thulium oxalate.

100 cc. aq. 20% triethylamine oxalate dissolve approx. 1.340 gms. thulium oxalate.
(Grant and James, 1917.)

THULIUM Bromonitrobenzene SULFONATE Tm(C₆H₃Br.NO₂.SO₃·1.4.2).-12H₂O.

100 gms. sat. solution in water contain 6.379 gms. of the anhydrous salt at 25°.
(Katz and James, 1913.)

The percentage solubility of Uranium in Mercury at 20°, determined by filtering an amalgam of the metal through a sintered glass filter, was found by Irvin and Russell, 1932, to be less than 1×10^{-5} .

URANYL FORMATE $\text{UO}_2(\text{HCOO})_2 \cdot \text{H}_2\text{O}$.

SOLUBILITY OF URANYL FORMATE IN AQUEOUS SOLUTIONS OF
FORMIC ACID AT 25°.
(Colani, 1929.)

The solutions were kept in darkness during the period of saturation. When uranyl formate is dissolved in water or dilute solutions of formic acid, a precipitate of basic formate separates after a short time. This increases in solubility with increase in concentration of formic acid until the neutral formate is formed. This latter then decreases in solubility with increase in the concentration of formic acid.

	Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase
	UO_2	HCOOH		UO_2	HCOOH	
	0.076	0.012	$\text{UO}_3 \cdot 2\text{H}_2\text{O} \cdot \text{UO}_2(\text{HCOO})_2 \cdot \text{H}_2\text{O}$	4.12	20.16	$\text{UO}_2(\text{HCOO})_2 \cdot \text{H}_2\text{O}$
	0.368	0.285	"	2.52	31.57	"
	0.759	0.806	"	1.15	44.85	"
	1.07	1.33	"	0.765	50.67	"
	3.06	4.88	"	0.325	61.23	"
	4.87	8.23	"	0.116	72.29	"
CH	6.05	10.87 (1)	" + $\text{UO}_2(\text{HCOO})_2 \cdot \text{H}_2\text{O}$	0.058	85.86	"
	5.71	12.33	$\text{UO}_2(\text{HCOO})_2 \cdot \text{H}_2\text{O}$	0.057	93.93	"

(1) This result corresponds to 7.99 gms. $\text{UO}_2(\text{HCOO})_2 \cdot \text{H}_2\text{O}$ per 100 gms. sat. solution at 25°.

URANYL ACETATE $\text{UO}_2(\text{CH}_3\text{COO})_2 \cdot 2\text{H}_2\text{O}$.

SOLUBILITY OF URANYL ACETATE IN AQUEOUS SOLUTIONS OF ACETIC ACID AT 25°.
(Colani, 1927a.)

	Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase
	UO_2	CH_3COOH		UO_2	CH_3COOH	
	0.549	0.270	2.1	3.11	30.70	$\text{UO}_2(\text{CH}_3\text{COO})_2 \cdot 2\text{H}_2\text{O}$
	0.883	0.499	"	2.88	36.9	"
	1.11	0.618	"	2.65	41.1	"
	1.28	0.747	"	2.36	46.4	"
	2.07	1.20	"	1.87	56.7	"
	4.12	2.32	" + 1.1.3	1.38	65.9	"
	4.47	2.49	1.1.3	0.831	77.4	"
	4.89	2.64 (1)	" + $\text{UO}_2(\text{CH}_3\text{COO})_2 \cdot 2\text{H}_2\text{O}$	0.858	79.9	" + 1.2.1
	4.54	2.87	$\text{UO}_2(\text{CH}_3\text{COO})_2 \cdot 2\text{H}_2\text{O}$	0.645	81.6	1.2.1
	4.07	4.55	"	0.405	88.2	"
	3.79	11.3	"	0.306	97.8	"
	3.30	24.8	"			

2.1 = $2(\text{UO}_2)(\text{OH})_2 \cdot \text{UO}_2(\text{CH}_3\text{COO})_2$; 1.2.1 = $\text{UO}_2(\text{CH}_3\text{COO})_2 \cdot 2\text{CH}_3\text{COOH} \cdot \text{H}_2\text{O}$;
1.1.3 = $\text{UO}_2(\text{OH})_2 \cdot \text{UO}_2(\text{CH}_3\text{COO})_2 \cdot 3\text{H}_2\text{O}$.

(1) This result corresponds to 7.24 gm. $\text{UO}_2(\text{CH}_3\text{COO})_2 \cdot 2\text{H}_2\text{O}$ and 0.39 gm. free acetic acid per 100 gms. sat. solution.

SOLUBILITY OF EACH SEPARATELY IN WATER.
(Courtois, 1914.)

Compound	Formula	t°	Gms. Anhydrous Ompd. per liter sat. sol.
Uranyl Formate	$UO_2[HC(=O)O]_2 \cdot 2H_2O$	15	72.0
" Acetate	$UO_2[CH_3C(=O)O]_2 \cdot 2H_2O$	17	77.3
" Propionate	$UO_2[C_2H_5C(=O)O]_2 \cdot 2H_2O$	19	84.8
" n Butyrate	$UO_2[C_3H_7C(=O)O]_2 \cdot 2H_2O$	17	105.3
" Iso "	" "	20	42.5
" n Valerate	$UO_2[C_4H_9C(=O)O]_2 \cdot 2H_2O$	14	37.2

100 gms. Methyl Alcohol dissolve 0.74 gm. anhydrous uranyl acetate at 15° and 0.83 gm. at 66° (b.pt.).

100 gms. Acetone dissolve 2.37 gms. anhydrous uranyl acetate at 15°.
(Henstock, 1934.)

URANYL Ammonium PROPIONATE $2UO_2(C_3H_5O_2)_2 \cdot NH_4C_3H_5O_2 \cdot 2H_2O$.

URANYL Potassium PROPIONATE $UO_2(C_3H_5O_2)_2 \cdot KC_3H_5O_2$.

CH

100 gms. aq. solution contain 16.48 gms. $2UO_2(C_3H_5O_2)_2 \cdot NH_4C_3H_5O_2$ at 29.8°.

100 gms. aq. solution contain 2.362 gms. $UO_2(C_3H_5O_2)_2 + 0.82$ gm. $KC_3H_5O_2$ at 29.4°, atomic relation, 1:1.29.
(Rimbach, 1904.)

URANYL Potassium BUTYRATE $UO_2(C_4H_7O_2)_2 \cdot KC_4H_7O_2$.

The double salt is decomposed by water at ordinary temperatures and the solution gets richer in uranyl butyrate. The solubility at 29.4° in water containing $KC_4H_7O_2$ is 2.10 gms. $UO_2(C_4H_7O_2)_2 + 0.38$ gm. $KC_4H_7O_2$ per 100 gms. solution. The atomic relation being 1:0.64.
(Rimbach, 1904.)

URANIUM HELIANTHATE $(C_{14}H_{14}N_3SO_3)_2 U \cdot 4H_2O$.

1000 cc. H_2O dissolve 0.30 gm. hydrated uranium helianthate at 20-25°.
(Stark and Dehn, 1918.)

URANYL Ammonium CARBONATE $UO_2CO_3 \cdot 2(NH_4)_2CO_3$.

SOLUBILITY IN WATER.
(Giolitti and Vecchiarelli, 1905.)

A large excess of the double carbonate was agitated with water at constant temperature and the clear saturated solutions analyzed.

CO

t°.	Gms. per 100 Gms. Sat. Sol.			Mol. Ratio.		
	U.	CO ₂ .	NH ₃ .	U	CO ₂	NH ₃ .
18.6	2.71	1.54	0.795	1	3.08	4.10
36.5	3.09	2.29	1.188	1	4.01	5.35
48.3	3.03	2.71	1.35	1	4.95	6.35
62	...	3.17	1.62	...	...	...
87.3	3.95	3.96	2.027	1	5.42	7.15

Theoretical molecular ratio for $UO_2CO_3 \cdot 2(NH_4)_2CO_3 = 1:3:4$.

Thus at the lower temperature, the composition of the dissolved salt is very near the ratio corresponding to the formula.

The author calculates that 6.04 gms. of $UO_2CO_3 \cdot 2(NH_4)_2CO_3$ are contained in 100 gms. of the sat. solution at 18.6° (a recalculation from the U value, 2.71, indicates that this figure should be 5.26 gms.).

U URANIUM 1562

URANYL Campho CARBONATE $\text{UO}_2(\text{C}_{11}\text{H}_{15}\text{O}_3)_2$.

SOLUBILITY OF URANYL CAMPHO CARBONATE IN SEVERAL SOLVENTS.
(Picon, 1931.)

Solvent	t°	Gms. $\text{UO}_2(\text{C}_{11}\text{H}_{15}\text{O}_3)_2$ per liter sat. sol.	Solvent	t°	Gms. $\text{UO}_2(\text{C}_{11}\text{H}_{15}\text{O}_3)_2$ per liter sat. sol.
Ethyl Ether	7	22.4	Benzene	7	79.1
Acetone	7	13.5	Chloroform	7	61.0
Ethyl Acetate	7	52.6	Olive Oil	15	5.84

URANYL OXALATE $\text{UO}_2\text{C}_2\text{O}_4\cdot 3\text{H}_2\text{O}$.

100 gms. H_2O dissolve 0.7401 gm. $\text{UO}_2\text{C}_2\text{O}_4\cdot 3\text{H}_2\text{O}$ at 25°. (Dittrich, 1899.)

SOLUBILITY OF URANYL OXALATE IN WATER. (Colani, 1925.)

t°	11.0	15.0	20.0	50.0	75.0	100.0
Gms. $\text{UO}_2\text{C}_2\text{O}_4$ per 100 gms. sat. sol.	0.45	0.47	0.50	1.00	1.65	3.06

The solid phase was $\text{UO}_2\text{C}_2\text{H}_4\cdot 3\text{H}_2\text{O}$ in all cases.

SOLUBILITY OF URANYL OXALATE IN AQUEOUS SOLUTIONS OF ACIDS.
(Colani, 1925.)

In Aq. HCl at 11°

Gms. per 100 gms. sat. sol.	HCl	$\text{UO}_2\text{C}_2\text{O}_4$
3.60	1.14	
8.20	2.00	
11.49	2.91	
14.99	4.90	
17.65	8.82	

In Aqueous Oxalic Acid at 15°

Gms. per 100 gms. sat. sol.	Solid Phase.	Gms. per 100 gms. sat. sol.	Solid Phase.
$\text{H}_2\text{C}_2\text{O}_4$	$\text{UO}_2\text{C}_2\text{O}_4\cdot 3\text{H}_2\text{O}$	$\text{H}_2\text{C}_2\text{O}_4$	$\text{H}_2\text{C}_2\text{O}_4\cdot 2\text{H}_2\text{O}$
1.40	1.56	7.49	1.55
2.66	1.86	7.55	1.20
4.12	2.02	7.56	0.78
5.18	2.09	7.48	0.39
7.33	2.19	7.46	0.00

In Aq. Nitric Acid at 20°.

Gms. per 100 gms. sat. sol.	HNO_3	$\text{UO}_2\text{C}_2\text{O}_4$
1.84	0.79	
5.34	1.19	
12.14	1.56	
17.60	1.76	
21.47	1.88	
31.00	2.28	

In Aq. Phosphoric Acid at 20°.

Gms. per 100 gms. sat. sol.	H_3PO_4	$\text{UO}_2\text{C}_2\text{O}_4$
0.77	2.10	
1.51	3.56	
2.67	5.66	
4.94	9.25	
8.75	15.14	
15.76	25.74	

In Aq. Sulfuric Acid at 20°.

Gms. per 100 gms. sat. sol.	H_2SO_4	$\text{UO}_2\text{C}_2\text{O}_4$	Gms. per 100 gms. sat. sol.	H_2SO_4	$\text{UO}_2\text{C}_2\text{O}_4$
0.00	0.50		15.07	3.85	
0.82	0.85		19.88	4.93	
2.59	1.34		25.58	5.98	
3.05	1.61		27.31	6.46	
5.53	2.04		29.67	7.49	

EQUILIBRIUM IN THE SYSTEM URANYL OXALATE, AMMONIUM OXALATE
AND WATER.
(Colani, 1917.)

Results at 15°.

Gms. per 100 Gms. Sat. Solution.	Solid Phase.
$\text{UO}_2\text{C}_2\text{O}_4\cdot (\text{NH}_4)_2\text{C}_2\text{O}_4$	
0.47	$\text{UO}_2\text{C}_2\text{O}_4\cdot 3\text{H}_2\text{O}$
7.19	" + $(\text{NH}_4)_2(\text{UO}_2)_2(\text{C}_2\text{O}_4)_3\cdot 3\text{H}_2\text{O}$
8.78	$(\text{NH}_4)_2(\text{UO}_2)(\text{C}_2\text{O}_4)_2\cdot 2\text{H}_2\text{O}$ + "
9.66	" + $(\text{NH}_4)_2\text{C}_2\text{O}_4\cdot \text{H}_2\text{O}$
0	$(\text{NH}_4)_2\text{C}_2\text{O}_4\cdot \text{H}_2\text{O}$

Results at 50°.

Gms. per 100 Gms. Sat. Solution.	Solid Phase.
$\text{UO}_2\text{C}_2\text{O}_4\cdot (\text{NH}_4)_2\text{C}_2\text{O}_4$	
I	$\text{UO}_2\text{C}_2\text{O}_4\cdot 3\text{H}_2\text{O}$
5.11	" + $(\text{NH}_4)_2(\text{UO}_2)_2(\text{C}_2\text{O}_4)_3$
19.89	$(\text{NH}_4)_2(\text{UO}_2)(\text{C}_2\text{O}_4)_2$ + "
23.82	" + $(\text{NH}_4)_2\text{C}_2\text{O}_4\cdot \text{H}_2\text{O}$
0	$(\text{NH}_4)_2\text{C}_2\text{O}_4\cdot \text{H}_2\text{O}$

Two determinations at 75° are also given.

EQUILIBRIUM IN THE SYSTEM URANYL OXALATE, POTASSIUM OXALATE AND WATER.

(Colani, 1916a.)

Results at 15°.

Gms. per 100 Gms. Sat. Solution.		Solid Phase.
$\text{UO}_2\text{C}_2\text{O}_4$	$\text{K}_2\text{C}_2\text{O}_4$	
0.47	0	$\text{UO}_2\text{C}_2\text{O}_4 \cdot 3\text{H}_2\text{O}$
1.34	0.42	" + $\text{K}_2(\text{UO}_2)_2(\text{C}_2\text{O}_4)_{3.4}\text{H}_2\text{O}$
3.89	1.83	$\text{K}_2(\text{UO}_2)(\text{C}_2\text{O}_4)_{2.3}\text{H}_2\text{O}$ + "
3.76	1.85	" + $\text{K}_4(\text{UO}_2)_2(\text{C}_2\text{O}_4)_{5.10}\text{H}_2\text{O}$
0.10	24.30	$\text{K}_2\text{C}_2\text{O}_4 \cdot \text{H}_2\text{O}$ + "
0	24.09	$\text{K}_2\text{C}_2\text{O}_4 \cdot \text{H}_2\text{O}$

Results at 50°.

Gms. per 100 Gms. Sat. Solution.		Solid Phase.
$\text{UO}_2\text{C}_2\text{O}_4$	$\text{K}_2\text{C}_2\text{O}_4$	
1	0	$\text{UO}_2\text{C}_2\text{O}_4 \cdot 3\text{H}_2\text{O}$
3.45	1.11	" + $\text{K}_2(\text{UO}_2)_2(\text{C}_2\text{O}_4)_{3.4}\text{H}_2\text{O}$
9.82	4.83	$\text{K}_2(\text{UO}_2)(\text{C}_2\text{O}_4)_2$ + "
9.59	5.61	" + $\text{K}_4(\text{UO}_2)_2(\text{C}_2\text{O}_4)_{5.10}\text{H}_2\text{O}$
1.22	32.65	$\text{K}_2\text{C}_2\text{O}_4 \cdot \text{H}_2\text{O}$ + "
0	32.75	$\text{K}_2\text{C}_2\text{O}_4 \cdot \text{H}_2\text{O}$

SOLUBILITY OF URANYL OXALATE IN AQUEOUS SODIUM OXALATE AT 25°.

(Dittrich, 1899.)

Gms. $\text{Na}_2\text{C}_2\text{O}_4$ per 100 cc. Solution.	Gms. $\text{UO}_2\text{C}_2\text{O}_4 \cdot 3\text{H}_2\text{O}$ per 100 cc. Sat. Solution.
0.6706	2.0125
0.3353	0.9867
0.2235	0.6059

URANYL CHLORIDE $\text{UO}_2\text{Cl}_2 \cdot 3\text{H}_2\text{O}$.100 gms. H_2O dissolve 320 gms. UO_2Cl_2 at 18°.

(Mylus and Dietz, 1901.)

SOLUBILITY OF URANYL AMMONIUM CHLORIDE, U. TETRA METHYL AMMONIUM CHLORIDE, U. TETRA ETHYL AMMONIUM CHLORIDE, U. CAESIUM CHLORIDE, U. RUBIDIUM CHLORIDE, AND U. POTASSIUM CHLORIDE IN WATER.

(Rimbach, 1904.)

Formula of Double Salt.	t°.	Gms. per 100 Gms. Sat. Sol.	Atomic Relation in Sol.	Solid Phase.
$\text{UO}_2\text{Cl}_2 \cdot 2\text{NH}_4\text{Cl} \cdot 2\text{H}_2\text{O}$	15	$40.67 \text{UO}_2 + 3.51 \text{NH}_4 + 19.15 \text{Cl}$	$r \text{UO}_2 : 1.59 \text{NH}_4 : 3.59 \text{Cl}$	1 Mol. double salt
$\text{UO}_2\text{Cl}_2 \cdot 2\text{N}(\text{CH}_3)_4\text{Cl}$	29.8	" + $10.44 \text{Cl}_2 = 41.24^*$	$r \text{UO}_2 : 4.02 \text{Cl}$	+ 0.4 Mol. NH_4Cl
	80.7	" + $10.52 \text{Cl}_2 = 41.91^*$	$r \text{UO}_2 : 3.98 \text{Cl}$	Double salt
$\text{UO}_2\text{Cl}_2 \cdot 2\text{N}(\text{C}_2\text{H}_5)_4\text{Cl}$	27.1	" + $7.81 \text{Cl}_2 = 37.15^\dagger$	$r \text{UO}_2 : 3.97 \text{Cl}$	"
	80.7	" + $7.78 \text{Cl}_2 = 37.23^\dagger$	$r \text{UO}_2 : 3.94 \text{Cl}$	"
$\text{UO}_2\text{Cl}_2 \cdot 2\text{CsCl}$	29.75	" + $22.5 \text{Cs} = 56.04^\ddagger$	$r \text{UO}_2 : 2.07 \text{Cs}$	"
$\text{UO}_2\text{Cl}_2 \cdot 2\text{RbCl} \cdot 2\text{H}_2\text{O}$	24.8	" + $16.6 \text{Rb} + 13.8 \text{Cl}_2$	$r \text{UO}_2 : 1.96 \text{Rb} : 3.90 \text{Cl}$	"
	80.3	" + $19.1 \text{Rb} + 13.8 \text{Cl}_2$	$r \text{UO}_2 : 1.98 \text{Rb} : 3.95 \text{Cl}$	"
$\text{UO}_2\text{Cl}_2 \cdot 2\text{KCl} \cdot 2\text{H}_2\text{O}$	0.8	" + $13.59 \text{Cl} + 3.86 \text{K}$	$r \text{UO}_2 : 2.69 \text{Cl} : 0.69 \text{K}$	The double salt is decomposed by water at temperatures below 60°.
"	14.9	" + $13.51 \text{Cl} + \dots \text{K}$	$r \text{UO}_2 : 3.06 \text{Cl} : 1.06 \text{K}$	
"	17.5	" + $14.50 \text{Cl} + 5.27 \text{K}$	$r \text{UO}_2 : 2.96 \text{Cl} : 0.96 \text{K}$	
"	25	" + $15.26 \text{Cl} + \dots \text{K}$	$r \text{UO}_2 : 3.33 \text{Cl} : 1.33 \text{K}$	
"	41.5	" + $15.92 \text{Cl} + 7.39 \text{K}$	$r \text{UO}_2 : 3.44 \text{Cl} : 1.44 \text{K}$	
"	50	" + $16.56 \text{Cl} + \dots \text{K}$	$r \text{UO}_2 : 3.71 \text{Cl} : 1.71 \text{K}$	
"	60	" + $17.25 \text{Cl} + 9.14 \text{K}$	$r \text{UO}_2 : 3.85 \text{Cl} : 1.85 \text{K}$	
"	71.5	" + $17.44 \text{Cl} + 9.28 \text{K}$	$r \text{UO}_2 : 3.96 \text{Cl} : 1.96 \text{K}$	Double salt
"	78.5	" + $18.24 \text{Cl} + 9.95 \text{K}$	$r \text{UO}_2 : 3.95 \text{Cl} : 1.95 \text{K}$	

$\text{UO}_2\text{Cl}_2 \cdot 2\text{N}(\text{CH}_3)_4\text{Cl}$ $\ddagger \text{UO}_2\text{Cl}_2 \cdot \text{N}(\text{C}_2\text{H}_5)_4\text{Cl}$ $\ddagger \text{UO}_2\text{Cl}_2 \cdot 2\text{CsCl}$
 $\S = 57.9 \text{ gms. } \text{UO}_2\text{Cl}_2 \cdot 2\text{RbCl}_2$ $\parallel = 65.8 \text{ gms. } \text{UO}_2\text{Cl}_2 \cdot 2\text{RbCl}_2$

URANYL Penta Antipyrine Per CHLORATE $[\text{UO}_2(\text{COC}_{10}\text{H}_{12}\text{N}_2)_5](\text{ClO}_4)_2$.

100 cc sat. solution of Uranyl Penta Antipyrine Perchlorate in Water contain 0.46 gm. $[\text{UO}_2(\text{COC}_{10}\text{H}_{12}\text{N}_2)_5](\text{ClO}_4)_2$ at 20°. (Wilke-Dörfurt and Schliephake, 1929.)

URANYL Sodium CHROMATE $2(\text{UO}_2)\text{CrO}_4 \cdot \text{Na}_2\text{CrO}_4 \cdot 10\text{H}_2\text{O}$.

100 gms. sat. aqueous solution contain 52.52 gms. $2(\text{UO}_2)\text{CrO}_4 \cdot \text{Na}_2\text{CrO}_4$ at 20°. (Rimbach, 1904.)

URANIUM

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URANYL Double FLUORIDES with Organic Bases

SOLUBILITY OF EACH SEPARATELY IN WATER AT 20°.
(Olsson, 1930.)

Organic Base	Formula of Double Fluoride	Gms. Compound per 100 cc sat. sol.
Pyridine	$C_5H_5NHUO_2F_3 \cdot H_2O$	1.289
"	$C_5H_5NH(UO_2)_2F_5 \cdot 3H_2O$	1.952
Quinoline	$C_9H_7NHUO_2F_3 \cdot H_2O$	0.126
"	$C_9H_7NH(UO_2)_2F_5 \cdot 2H_2O$	0.979
Tetra Methyl Ammonium	$(CH_3)_4N(UO_2)_2F_5 \cdot 2H_2O$	0.143
" Ethyl "	$(C_2H_5)_4NUO_2F_3$	0.716
" " "	$(C_2H_5)_4N(UO_2)_2F_5 \cdot 2H_2O$	0.771
Tri methyl -p- Toly Ammonium	$C_6H_4CH_3(CH_3)_3 \cdot NUO_2 \cdot 2H_2O$	1.645
" " " " "	$C_6H_4CH_3(CH_3)_3N(UO_2)_2F_5 \cdot H_2O$	3.091
Tri methyl pyridine	$C_5H_2(CH_3)_3NH(UO_2)_3F_7 \cdot 6H_2O$	0.708
Di ethyl aniline	$C_6H_5N(C_2H_5)_2H(UO_2)_2F_3 \cdot 2H_2O$	1.759
" " "	$C_6H_5N(C_2H_5)_2H(UO_2)_2F_5 \cdot H_2O$	3.896
Tri ethyl sulfine	$(C_2H_5)_3S(UO_2)_2F_5 \cdot 2H_2O$	0.897

URANYL IODATE $UO_2(IO_3)_2$.

SOLUBILITY OF THE DIFFERENT CRYSTALLINE FORMS IN WATER AT 18°.
(Artmann, 1912-13.)

Appearance of Crystals.

	Type I warty, later prismatic needles	Gms. $UO_2(IO_3)_2$ per 100 Gms. H_2O .
$UO_2(IO_3)_2 \cdot H_2O$	Type II pyramids, sphenoids	0.1049
		0.1214
$UO_2(IO_3)_2 \cdot 2H_2O$		0.2044

URANYL NITRATE $UO_2(NO_3)_2 \cdot 6H_2O$.

SOLUBILITY IN WATER.
(Wassilieff, 1916.)

t°.	Gms. $UO_2(NO_3)_2$ per 100 Gms. Sat. Sol.	Solid Phase.	t°.	Gms. $UO_2(NO_3)_2$ per 100 Gms. Sat. Sol.	Solid Phase.
— 1.6	10.83	Ice	— 2.2	48.77	$UO_2(NO_3)_2 \cdot 6H_2O$
— 2.1	12.24	"	0	49.46	"
— 2.9	17.19	"	5.5	50.55	"
— 4.4	23.52	"	12.3	52.88	"
— 6	26.20	"	21.1	55.98	"
— 7.9	32.53	"	25.6	57.17	"
— 11.2	37.09	"	36.7	61.27	"
— 18.1	43.12	" + $UO_2(NO_3)_2 \cdot 6H_2O$	45.2	65.12	"
— 12.1	45.53	$UO_2(NO_3)_2 \cdot 6H_2O$	51.8	67.76	"

Data for the densities of uranyl nitrate solutions in water and other solvents are given by de Coninck (1900).

More recent determinations of the solubility of Uranyl Nitrate in Water by Guempel, 1929, gave the following results.

t°	Gms. $\text{UO}_2(\text{NO}_3)_2$ per 100 gms. sat. sol.	Solid Phase	t°	Gms. $\text{UO}_2(\text{NO}_3)_2$ per 100 gms. sat. sol.	Solid Phase
- 0.3	7.87	Ice	25.0	55.90	$\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$
- 2.9	17.33	"	25.0	56.08(1)	"
- 5.4	24.85	"	36.1	60.28	"
- 7.3	29.60	"	43.6	64.20	"
-18.0	43.04	"	54.5	70.25	"
-18.1 Eutec.	43.10	"	57.4	72.76	"
-11.5	46.25	$\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$	58.6	75.65	"
- 5.55	48.47	"	62.9	76.83	$\text{UO}_2(\text{NO}_3)_2 \cdot x\text{H}_2\text{O}$
+ 7.6	51.57	"	72.4	78.50	"
15.0	52.80	"	80.6	80.20	"
20.0	54.40	"	88.5	81.13	"

(1) Colani, 1928.

EQUILIBRIUM IN THE SYSTEM URANYL NITRATE, NITRIC ACID AND WATER AT 25°.
(Colani, 1926.)

Gms. per 100 gms. sat. sol.		Solid Phase.	Gms. per 100 gms. sat. sol.		Solid Phase.
Free HNO_3 .	$\text{UO}_2(\text{NO}_3)_2$.		Free HNO_3 .	$\text{UO}_2(\text{NO}_3)_2$.	
0.0	56.08	$\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$	46.12	27.18	$\text{UO}_2(\text{NO}_3)_2 \cdot 3\text{H}_2\text{O}$
12.35	40.36	"	50.43	25.79	"
25.14	30.29	"	53.20	26.77	"
28.67	29.65	"	53.71	27.49	"
29.84	31.27	"	55.24	27.24	$\text{UO}_2(\text{NO}_3)_2 \cdot 2\text{H}_2\text{O}$
30.43	36.72	"	60.38	23.65	"
30.15	37.99	"	66.71	22.29	"
32.31	36.28	$\text{UO}_2(\text{NO}_3)_2 \cdot 3\text{H}_2\text{O}$	68.83	22.49	"

SOLUBILITY OF URANYL NITRATE HEXAHYDRATE IN AQUEOUS NITRIC ACID AT 20°.
(Nichols; Howes, et. al. 1919.)

Per cent concentration of aq. HNO_3	10.0	20.0	30.0	40.0	70.0
Gms. $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$ per 100 gms. solvent..	160.0	115.0	80.0	65.0	65.0

100 gms. abs. acetone dissolve 1.5 gms. $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$ at 12°. (de Coninck, 1900.)

100 gms. 85% alcohol dissolve 3.3 gms. $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$ at 12°. "

100 gms. sat. solution of anhydrous Uranyl Nitrate in Ethyl Ether contain 0.95 gm. $\text{UO}_2(\text{NO}_3)_2$ at 20°. (Guempel, 1929.)

5 SOLUBILITY OF URANYL NITRATE IN ETHER.
(Lebeau, 1911.)

When a large excess of uranyl nitrate is shaken with ether at 7°, two liquid layers are formed. The ethereal layer contains 59 gms. $\text{UO}_2(\text{NO}_3)_2$ per 100 gms. of solution and the aqueous layer contains 62.5 gms. per 100 gms. of solution. An elevation of temperature was noted when ether and $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$ were mixed at room temperature, therefore, indicating that solution is accompanied by combination and elimination of the water of the salt.

EQUILIBRIUM IN THE SYSTEM URANYL NITRATE, ETHYL ETHER AND WATER AT 0°.
(Misciatelli, 1930.)

Gms. per 100 gms. lower layer			Gms. per 100 gms. upper layer			Solid Phase
(C ₂ H ₅) ₂ O	H ₂ O	UO ₂ (NO ₃) ₂	(C ₂ H ₅) ₂ O	H ₂ O	UO ₂ (NO ₃) ₂	
0	52.0	48.0	—	—	—	UO ₂ (NO ₃) ₂ ·6H ₂ O
4.15	47.47	48.38	45.15	10.29	44.56	"
5.00	46.30	48.70	41.17	13.56	45.27	"
5.50	65.50	38.00	67.50	6.50	26.00	None
6.48	65.00	28.52	87.85	3.02	9.13	"
9.48	66.56	25.09	86.46	6.95	6.58	"
7.05	73.50	19.38	97.49	0.96	1.55	"
9.79	77.74	12.47	98.53	1.60	0.31	"
11.6	88.40	—	99.0	1.0	—	"
—	—	—	68.0	7.0	24.5	"
—	—	—	78.0	—	22.0	"

EQUILIBRIUM IN THE SYSTEM URANYL NITRATE, ETHYL ETHER
AND WATER AT 20°.
(Quempel, 1929; Misciatelli, 1930.)

Gms. per 100 gms. lower layer			Gms. per 100 gms. upper layer			Solid Phase
(C ₂ H ₅) ₂ O	H ₂ O	UO ₂ (NO ₃) ₂	(C ₂ H ₅) ₂ O	H ₂ O	UO ₂ (NO ₃) ₂	
—	45.6	54.4	—	—	— (G) (M)	UO ₂ (NO ₃) ₂ ·6H ₂ O
3.30	42.47	54.23	38.12	12.80	49.08 (G)	"
3.87	43.52	52.61	42.88	8.10	49.02 (M)	"
4.00	60.0	36.0	67.10	7.0	25.90 (H)	None
3.30	42.47	54.23	49.08	12.80	38.12 (G)	"
4.5	72.0	23.5	96.0	1.50	2.5 (M)	"
5.3	56.44	38.26	62.50	8.25	29.25 (G)	"
6.1	75.33	18.57	96.0	3.11	0.89 (G)	"
6.50	93.5	—	99.0	1.0	— (M)	"
—	—	—	86.4	1.10	12.50 (M)	UO ₂ (NO ₃) ₂
—	—	—	91.22	—	8.78 (H)	"

URANYL Potassium NITRATES UO₂(NO₃)₂·KNO₃, UO₂(NO₃)₂·2KNO₃.
SOLUBILITY OF URANYL POTASSIUM NITRATES IN AQUEOUS NITRIC ACID AT 20°.
(Nichols, Howes et. al., 1919.)

Results for UO₂(NO₃)₂·KNO₃

Per cent HNO ₃ in solvent.	Gms. UO ₂ (NO ₃) ₂ ·KNO ₃ per 100 gms. solvent.	Solid Phase.
0.0	85.5	KNO ₃
10.0	82.0	"
20.0	99.8	"
30.0	89.0	UO ₂ (NO ₃) ₂ ·6H ₂ O
30.0	89.5	UO ₂ (NO ₃) ₂ ·KNO ₃
40.0	81.0	"
50.0	54.0	"
60.0	33.9	"

Results for UO₂(NO₃)₂·2KNO₃

Per cent HNO ₃ in solvent.	Gms. UO ₂ (NO ₃) ₂ ·2KNO ₃ per 100 gms. solvent.	Solid Phase.
0.0	62.9	KNO ₃
10.0	52.2	"
20.0	45.7	"
30.0	51.8	"
40.0	67.2	"
50.0	52.3	UO ₂ (NO ₃) ₂ ·2KNO ₃
50.0	57.2	UO ₂ (NO ₃) ₂ ·KNO ₃

URANYL DOUBLE NITRATES.

SOLUBILITY OF URANYL AMMONIUM NITRATE + URANYL NITRATE; U. CAESIUM NITRATE + CAESIUM NITRATE; U. POTASSIUM NITRATE + POTASSIUM NITRATE AND U. RUBIDIUM NITRATE + RUBIDIUM NITRATE IN WATER.

(Rimbach, 1904.)

Formula of Salt.	t°.	Gms. per 100 Gms. Sat. Solution.		Atomic Relation in Solution.
		UO ₂ .	Total Salt.	
UO ₂ (NO ₃) ₂ .NH ₄ NO ₃	0.5	29.71 + 2.92 NH ₄	= ...	1 UO ₂ : 1.47 NH ₄ : 3.47 NO ₃
"	24.9	36.46 + 3.54 "	= 68.95	" : 1.46 " : 3.46 "
"	59	44.37 + 2.90 "	= ...	" : 0.98 " : 2.98 "
"	80.7	44.95 + 2.98 "	= 78.95	" : 1 " : 3 "
UO ₂ (NO ₃) ₂ .CsNO ₃	16	31.39 + 6.59 Cs	= 55.4	" : 0.44 Cs
UO ₂ (NO ₃) ₂ .KNO ₃	0.5	31.08 + 1.72 K	= ...	" : 2.37 NO ₃ : 0.37 K
"	13	33.40 + 2.72 "	= ...	" : 2.57 " : 0.57 "
"	25	37.07 + 4.01 *	= 64.82	" : 1.60 " : 0.76 "
"	45	42.18 + 5.16 "	= ...	" : 2.84 " : 0.84 "
"	59	41.65 + 6.03 "	= ...	" : 3 " : 1 "
"	80.6	43.71 + 6.38 "	= 80.1	" : 3.01 " : 1.01 "
UO ₂ (NO ₃) ₂ .RbNO ₃	25	35.41 + 4.65 Rb†	= 59.60	" : 1.40 " : 0.45 Rb
"	80	34.66 + 11.01 "	= 69.49	" : 3 " : 1.01 "

* + 23.5NO₃.

† + 19.74NO₃.

URANYL SULFATE UO₂SO₄.3H₂O.

SOLUBILITY IN SEVERAL SOLVENTS.

(de Coninck, 1901, 1903.)

Solvent	t°.	Gms. UO ₂ SO ₄ . 3H ₂ O per 100 Gms. Solvent.	Solvent.	t°.	Gms. UO ₂ SO ₄ . 3H ₂ O per 100 Gms. Solvent.
Water	13.2	18.9	Conc. HBr (d = 1.21)	12	16.8
Water	15.5	20.5	Conc. HNO ₃	12	9.1
16.2% Alcohol	10	12.3	Conc. H ₂ SO ₄ (d = 1.138)	13	24.3
85% Alcohol	16	2.6	1 Vol. HCl + 1 Vol. HNO ₃	16	18
Conc. HCl	13	30	Selenic Acid (d = 1.4)	15	27

SOLUBILITY OF URANYL SULFATE IN AQUEOUS SOLUTIONS OF
SULFURIC ACID AT 25°.

(Colani, 1928.)

Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase
UO ₂ SO ₄	H ₂ SO ₄ (free)		UO ₂ SO ₄	H ₂ SO ₄ (free)	
61.18	0.0	UO ₂ SO ₄ .3H ₂ O	6.62	59.83	1.1.5
58.96	1.64	"	4.69	63.82	"
47.96	10.56	"	3.81	67.40	"
30.03	25.42	"	4.70	70.70	"
28.65	26.99	" + UO ₂ SO ₄ .2H ₂ O	7.09	72.49	" + 1.1.2
27.25	28.00	UO ₂ SO ₄ .2H ₂ O	6.74	75.33	1.1.2
21.79	30.53	"	10.72	74.81	"
17.03	40.19	"	16.90	71.14	"
15.77	43.45	"	19.10	69.18	"
15.88	45.22	"	19.65	68.93	" + 1.1.1
17.74	47.75	" + 1.1.5	17.76	71.52	1.1.1
16.00	49.86	1.1.5	11.37	78.78	"
12.13	53.32	"	7.81	82.86	"
			3.77	89.62	"

1.1.5 = UO₂SO₄.H₂SO₄.5H₂O; 1.1.2 = UO₂SO₄.H₂SO₄.2H₂O; 1.1.1 = UO₂SO₄.
H₂SO₄.1/2H₂O.

URANYL Potassium SULFATE $\text{UO}_2\text{SO}_4 \cdot \text{K}_2\text{SO}_4 \cdot 2\text{H}_2\text{O}$.

100 gms. sat. aq. solution contain 10.41 gms. $\text{UO}_2\text{SO}_4 \cdot \text{K}_2\text{SO}_4$ at 25° and 23.13 gms. at 70.5°.
(Rimbach, 1904.)

SOLUBILITY OF $\text{UO}_2\text{SO}_4 \cdot 2\text{K}_2\text{SO}_4 \cdot 2\text{H}_2\text{O} + \text{UO}_2\text{SO}_4 \cdot \text{K}_2\text{SO}_4 \cdot 2\text{H}_2\text{O}$ IN WATER.

t°.	Gms. per 100 Gms. Solution.			Atomic Relation in Sol.			Mol. % in Solid Phase.	
	UO_2 .	K.	SO_4 .	UO_2 .	K.	SO_4 .	Mono Salt.	Di Salt.
14	0.85	4.19	5.71	1 : 35.75	1 : 18.88		29	71
50	6.70	8.15	12.37	1 : 5.20	1 : 8.40		76	24
80	14.29	8.54	15.53	1 : 4.13	1 : 3.06		12	88

URANIUM SULFATE (ous) $\text{U}(\text{SO}_4)_2$.**SOLUBILITY IN WATER.**
(Giollitti and Bucci, 1905.)

t°.	Gms. $\text{U}(\text{SO}_4)_2$ per 100 Gms. Sat. Sol.	Solid Phase.	t°.	Gms. $\text{U}(\text{SO}_4)_2$ per 100 Gms. Sat. Sol.	Solid Phase.
18	10.17	$\text{U}(\text{SO}_4)_2 \cdot 8\text{H}_2\text{O}$	93	63.2	$\text{U}(\text{SO}_4)_2 \cdot 8\text{H}_2\text{O}$
25.6	13.32	"	24	9.8	$\text{U}(\text{SO}_4)_2 \cdot 4\text{H}_2\text{O}$
37	19.98	"	37	8.3	"
48.2	28.72	"	48.2	8.1 (7.8)	"
62	36.8	"	63	7.3	"

The determinations were made with difficulty on account of the considerable tendency towards formation of basic sulfate and simultaneous clouding of the solution.

APPROXIMATE SOLUBILITY OF URANIUM SULFATE, IN AQUEOUS SOLUTIONS.
(de Coninck, 1903.)

SO

Solvent.	t°.	Gms. $\text{U}(\text{SO}_4)_2 \cdot 4\text{H}_2\text{O}$ per 100 Gms. Solvent.	Solvent.	t°.	Gms. $\text{U}(\text{SO}_4)_2 \cdot 4\text{H}_2\text{O}$ per 100 Gms. Solvent.
Water	11	23.2	Dilute Selenic Acid (1:4)	11.4	21.7
Dilute HCl (1:4)	9	17.2	Dilute H_2SO_4 (1:4)	10	15.6
Dilute HNO_3 (1:4)	10.5	18.2	Dilute Alcohol (1:4)	11.3	12.3

URANIUM SULFATE (ous) $\text{U}(\text{SO}_4)_2$.**SOLUBILITY OF URANIUM SULFATE IN 0.1 NORMAL SULFURIC ACID SOLUTIONS.**
(Meyer and Nachod, 1924.)

Tenth normal sulfuric acid was used as solvent instead of water to prevent hydrolysis to $\text{UO SO}_4 \cdot 2\text{H}_2\text{O}$. The saturated solutions were prepared by constant agitation for 12 hours of 3-5 gms. of each hydrate with 10-12 cc. of 0.1 N acid.

t°.	Gms. $\text{U}(\text{SO}_4)_2$ per 100 gms. sat. sol.	Solid Phase.	t°.	Gms. $\text{U}(\text{SO}_4)_2$ per 100 gms. sat. sol.	Solid Phase.
15.5 . . .	6.61	$\text{U}(\text{SO}_4)_2 \cdot 8\text{H}_2\text{O}$	92.0 . . .	6.61	Polymeric 4 Hydrate
20.0 . . .	8.78	"	22.7 . . .	13.68	$\text{U}(\text{SO}_4)_2 \cdot 4\text{H}_2\text{O}$
22.4 . . .	9.68	"	25.0 . . .	12.62	"
25.0 . . .	11.22	"	30.4 . . .	10.92	"
30.4 . . .	13.88	"	41.0 . . .	8.98	"
40.0 . . .	18.50	"	50.0 . . .	8.32	"
60.0 . . .	29.93	"	80.0 . . .	6.93	"

VANADIUM V.

The percentage solubility of Vanadium in Mercury at 20°, determined by filtering an amalgam of the metal through a sintered glass filter, was found by Irvin and Russell, 1932, to be less than 5×10^{-5} .

VANADIUM Pent OXIDE V_2O_5 .

100 gms. sat. solution of Vanadium Pentoxide in Water at 25° contain 0.07 gm. V_2O_5 at 25° and 0.07 gm. at 100°. (Meyer and Aulich, 1930.)

XENON Xe.

SOLUBILITY IN WATER.

(von Antropoff, 1909-10.)

The results are in terms of the coef. of absorption β , as defined by Bunsen (see p. 553) and modified by Kuenen in respect to the substitution of mass for volume of water.

t°.	0°.	10°.	20°.	30°.	40°.	50°.
Abs. Coef. β	0.2180	0.1500	0.1109	0.0900	0.0812	0.0878

SOLUBILITY OF XENON IN WATER AND IN ANILINE. (Antropoff, 1919.)

The determinations were made with the highest accuracy possible. An apparatus was used in which the solvent and its vapor touched no cock. The results are expressed in terms of the Bunsen absorption coefficient β , as modified by Kuenen. They show the volume of xenon in cubic centimeters (reduced to 0° and 760 mm.) dissolved by *one gram* of solvent.

t°.	Coef. of absorption β in		t°.	Coef. of absorption β in		Xe
	Water.	Aniline.		Water.	Aniline.	
0.....	0.242	-	30.....	0.098	0.455	
10.....	0.174	0.669	40.....	0.082	0.431	
20.....	0.123	0.501	50.....	0.073	0.411	

SOLUBILITY OF XENON IN LIQUID OXYGEN.

(v. Stackelberg, 1934.).

The determination of the saturation point was made by means of vapor pressure measurements.

t°	Mol. Xe per 1.0 mol. Xe + O
70	0.141
80	0.217
90	0.304

YTTRIUM BROMIDE YBr_3 .

SOLUBILITY OF YTTRIUM BROMIDE IN WATER. (Crew, Stewart and Hopkins, 1923.)

The solutions were saturated by frequent agitation during 5 hours and equilibrium was approached from above and from below.

t°.	Gms. YBr_3 per 100 gms. H_2O .	t°.	Gms. YBr_3 per 100 gms. H_2O .
0.....	64.0	75.....	111.3
30.....	83.3	95.....	129.6
50.....	96.1		

YTTRIUM ACETATE $Y(CH_3COO)_3 \cdot 4H_2O$.

100 gms. sat. solution of yttrium acetate in water prepared by constant rotation for 24 hours contained 8.28 gms. $Y(CH_3COOH)_3$ at 25°. (Meyer and Maller, 1920).

YTTRIUM GLYCOLATE $Y(C_2H_3O_3)_3 \cdot 2H_2O$.

One liter of water dissolves 2.447 gms. of the salt at 20°.

(Jantsch and Grünkraut, 1912-1913.)

YTTRIUM LACTATE $Y(C_3H_5O_3)_3 \cdot 2H_2O$.

1000 cc. sat. solution of yttrium lactate in water prepared by constant rotation in a thermostat contain 1.096 gm. $Y(C_3H_5O_3)_3 \cdot 2H_2O$ at 20°. (Jantsch, 1926.)

YTTRIUM MALONATE $Y_2(C_3H_3O_4)_3 \cdot 8H_2O$.

SOLUBILITY IN AQUEOUS MALONIC ACID AND AMMONIUM MALONATE SOLUTIONS.

(Holmberg, 1907.)

Solvent.	t°.	Gms. $Y_2(C_3H_3O_4)_3$ per 100 Gms. Solvent.
1 Gm. Am. Malonate per 10 cc. Solution	20	0.3
2 Gms. Malonic Acid per 10 cc. Solution	20	2.3

YTTRIUM TARTRATE $Y_2(C_4H_4O_6)_3 \cdot 5H_2O$.

SOLUBILITY IN AQUEOUS TARTARIC ACID AND AMMONIUM TARTRATE SOLUTIONS AT 20°. (Holmberg, 1907.)

Aq. Solvent.	Gms. $Y_2(C_4H_4O_6)_3$ per 100 Gms. Sat. Sol.	Aq. Solvent.	Gms. $Y_2(C_4H_4O_6)_3$ per 100 Gms. Sat. Sol.
1 gm. Am. Tartrate per 10 cc. solution	0.6	2 gms. Tartaric Acid per 10 cc. solution	0.02
2 gms. Am. Tartrate per 10 cc. solution	1.1	4 gms. Tartaric Acid per 10 cc. solution	0.02

YTTRIUM SULFONATES

SOLUBILITY OF YTTRIUM SULFONATES IN WATER.

Sulfonate.	Formula.	t°.	Gms. Anhy. Sulfonate per 100 Gms. H_2O .	Authority.
Yttrium Benzene Sulfonate	$Y(C_6H_5SO_3)_3 \cdot 9H_2O$	15	60.4	(Holmberg, 1907.)
“ “ m Nitro- benzene Sulfonate	$Y(C_6H_4NO_3SO_3)_3 \cdot 7H_2O$	15	48.3	
Yttrium Bromonitrobenzene Sulfonate	$Y(C_6H_3BrNO_2SO_3 \cdot 1.4 \cdot 2)_3 \cdot 10H_2O$	25	3.88	(Katz & James, '13.)

YTTRIUM CobaltiCYANIDE $Y_2(CoC_6N_6)_2 \cdot 9H_2O$.

1000 gms. aq. 10% HCl ($d_{15} = 1.05$) dissolve 2.78 gms. of the salt at 25°.

(James and Willand, 1916.)

YTTRIUM OXALATE $Y_2(C_2O_4)_3 \cdot 9H_2O$.

One liter H_2O dissolves 0.001 gm. $Y_2(C_2O_4)_3$ at 25° , determined by the electrolytic method. (Rimback and Schubert, 1909.)

100 gms. aqueous ammonium oxalate solution (3.26% $(NH_4)_2C_2O_4 \cdot H_2O$) dissolve 0.01714 gm. $Y_2(C_2O_4)_3 \cdot 9H_2O$ at room temp. (Cleve, 1902.)

100 gms. aq. 2.16 N H_2SO_4 dissolve 0.6884 gm. $Y_2(C_2O_4)_3$ at 25° . (Wirth, 1912.)

100 gms. aq. 4.32 N H_2SO_4 dissolve 1.4 gms. $Y_2(C_2O_4)_3$ at 25° . "

100 cc. aq. 20% methylamine oxalate dissolve 0.877 gm. yttrium oxalate at ord. temp.

100 cc. aq. 20% ethylamine oxalate dissolve 1.653 gms. yttrium oxalate at ord. temp.

100 cc. aq. 20% triethylamine oxalate dissolve 1.006 gms. yttrium oxalate at ord. temp. (Grant and James, 1917.)

YTTRIUM Potassium OXALATE $Y_2(C_2O_4)_3 \cdot 4K_2C_2O_4 \cdot 12H_2O$.

SOLUBILITY IN WATER AT 25° . (Pratt and James, 1911.)

The determinations were made with great care. The mixtures were constantly rotated for 8 weeks.

d_{25} of Sat. Sol.	Gms. per 100 Gms. H_2O .	Solid Phase.	d_{25} of Sat. Sol.	Gms. per 100 Gms. H_2O .	Solid Phase.
	$Y_2(C_2O_4)_3 \cdot K_2C_2O_4$.			$Y_2(C_2O_4)_3 \cdot K_2C_2O_4$.	
1.008	Trace	1.31	Solid Solution	1.174	1.50 27.44 $Y_2(C_2O_4)_3 \cdot 4K_2C_2O_4 \cdot 12H_2O$
1.035	0.02	5.30	"	1.199	1.49 32.83
1.059	0.06	8.88	"	1.222	1.48 37.68
1.096	0.27	14.50	"	1.231	1.42 39.12 $K_2C_2O_4$
1.132	0.72	20.27	"	1.228	1.09 38.77
1.166	1.37	26.02 $Y_2(C_2O_4)_3 \cdot 4K_2C_2O_4 \cdot 12H_2O$	1.218	0	37.87

SOLUBILITY OF YTTRIUM OXALATE IN AQUEOUS SOLUTIONS OF NITRIC ACID ALONE AND CONTAINING OXALIC ACID AT 90° .

(Neckers and Kramers, 1928.)

Conc. of Aq. HNO_3 in normality	Gms. Y_2O_3 per 100 cc sat. sol.	Solid Phase
2.5	1.3180	$Y_2(C_2O_4)_3 \cdot 9H_2O$
5.0	3.0135	"
2.5 + 5% $(COOH)_2$	0.4315	"
5.0 + "	1.4515	"

YTTRIUM CHLORIDE $YCl_3 \cdot 6H_2O$.

SOLUBILITY OF YTTRIUM CHLORIDE IN WATER.

(Crew, Steinert and Hopkins, 1925; Williams, Fogg and James, 1925.)

t° .	Gms. YCl_3 per 100 gms. sat. sol.	Solid Phase.	t° .	Gms. YCl_3 per 100 gms. sat. sol.	Solid Phase.
	C. S. and H. W. F. and J.			C. S. and H. W. F. and J.	
0...	42.36	43.60 $YCl_3 \cdot 6H_2O$	40...	43.30	44.70 $YCl_3 \cdot 6H_2O$
10...	42.65	43.85	50...	43.45	45.07
20...	42.87	44.08	60...	43.60	"
25...	42.95	44.20	70...	43.75	"
30...	43.07	44.33	80...	43.86	"

SOLUBILITY OF YTTRIUM CHLORIDE IN AQUEOUS HYDROCHLORIC ACID OF DENSITY 1.1051. (Williams, Fogg and James, 1925.)

Constant agitation in a thermostat for 9 hours and approaching equilibrium from above and below was employed.

t° .	Gms. YCl_3 per 100 gms. sat. sol.	Solid Phase.	t° .	Gms. YCl_3 per 100 gms. sat. sol.	Solid Phase.
10.....	24.35	$YCl_3 \cdot 6H_2O$	40.....	26.52	$YCl_3 \cdot 6H_2O$
20.....	24.63	"	50.....	27.55	"
30.....	25.48	"			

YTTRIUM CHLORIDE YCl_3 .

100 gms. alcohol dissolve	61.1 gms. YCl_3 at 15° .	(Matignon, 1906.)
" "	60.5 gms. YCl_3 at 20° .	(Matignon, 1909.)
" pyridine dissolve	6.5 gms. YCl_3 at 15° .	(Matignon, 1906.)

YTTRIUM Hexa Antipyrine Per CHLORATE $\text{Y}(\text{COC}_{10}\text{H}_{12}\text{N}_2)_6(\text{ClO}_4)_3$.

100 cc sat. solution of the salt in water contain 0.55 gm.
 $\text{Y}(\text{COC}_{10}\text{H}_{12}\text{N}_2)_6(\text{ClO}_4)_3$ at 20° . (Wilke-Dörfurt and Schliephake, 1928.)

YTTRIUM Hexa Antipyrine IODIDE $\text{Y}(\text{COC}_{10}\text{H}_{12}\text{N}_2)_6\text{I}_3$.

100 cc sat. solution of the salt in water contain 4.44 gm.
 $\text{Y}(\text{COC}_{10}\text{H}_{12}\text{N}_2)_6\text{I}_3$ at 20° . (Wilke-Dörfurt and Schliephake, 1928.)

YTTRIUM IODATE $\text{Y}(\text{IO}_3)_3 \cdot 3\text{H}_2\text{O}$.

100 gms. H_2O dissolve 0.53 gm. yttrium iodate. (Berlin.)

YTTRIUM NITRATE $\text{Y}(\text{NO}_3)_3$.

SOLUBILITY OF YTTRIUM NITRATE IN WATER. (Crew, Steinert and Hopkins, 1925.)

Saturation was obtained by frequent agitation during 5 hours and approaching equilibrium from above and from below.

t° .	Gms. $\text{Y}(\text{NO}_3)_3$ per 100 gms. H_2O .	t° .	Gms. $\text{Y}(\text{NO}_3)_3$ per 100 gms. H_2O .
0.0.....	93.1	60.2.....	200.0
22.5.....	134.5	66.5.....	211.0
35.0.....	155.0		

YTTRIUM Basic NITRATE $3\text{Y}_2\text{O}_3 \cdot 4\text{N}_2\text{O}_5 \cdot 2\text{H}_2\text{O}$.

EQUILIBRIUM IN THE SYSTEM YTTRIUM NITRATE, YTTRIUM HYDROXIDE
 AND WATER AT 25° . (James and Pratt, 1910.)

The determinations were made with very great care. The mixtures were rotated $4\frac{1}{2}$ months.

d_{25} of Sat. Sol.	Gms. per 100 Gms. H_2O .		Solid Phase.	d_{25} of Sat. Sol.	Gms. per 100 Gms. H_2O .		Solid Phase.
	$\text{Y}(\text{NO}_3)_3$.	Y_2O_3 as $\text{Y}(\text{OH})_3$.			$\text{Y}(\text{NO}_3)_3$.	Y_2O_3 as $\text{Y}(\text{OH})_3$.	
1.0260	3.13	0.014	$\text{Y}(\text{OH})_3$	1.4867	73.03	0.078	$3\text{Y}_2\text{O}_3 \cdot 4\text{N}_2\text{O}_5 \cdot 2\text{H}_2\text{O}$
1.1106	13.87	0.034	"	1.5587	89.06	0.074	"
1.1907	24.94	0.063	"	1.6259	103.80	0.075	"
1.2517	33.02	0.160	" $+ 3\text{Y}_2\text{O}_3 \cdot 4\text{N}_2\text{O}_5 \cdot 2\text{H}_2\text{O}$	1.6931	122.40	0.080	"
1.3268	44.35	0.114	$3\text{Y}_2\text{O}_3 \cdot 4\text{N}_2\text{O}_5 \cdot 2\text{H}_2\text{O}$	1.7440	137.10	0.083	" $+ \text{Y}(\text{NO}_3)_3$
1.4104	58.61	0.095	"	1.7446	141.6	0	$\text{Y}(\text{NO}_3)_3$

100 cc of a sat. solution of Yttrium Nitrate in Ethyl Ether prepared by frequent agitation and allowing to stand over night at about 20° , contain 0.792 gm. Y_2O_3 . A saturated ethereal solution prepared as above but using yttrium nitrate dehydrated at 150° , contains 0.803 gm. Y_2O_3 per 100 cc. (Wells, 1930.)

YTTRIUM OXIDE Y_2O_3 .

One liter sat. solution of Yttrium Oxide in Water contain 0.000008 gm. mol. Y_2O_3 at 29° as determined by electrometric titration.
(Busch, 1927.)

YTTRIUM DimethylPHOSPHATE $Y_2[(CH_3)_2PO_4]_6$.

100 gms. H_2O dissolve 2.8 gms. $Y_2[(CH_3)_2PO_4]_6$ at 25° and 0.55 gm. at 95° .
(Morgan and James, 1914.)

The following determinations differing from the above are given by Marsh, 1939.

t°	Gms. $Y_2[(CH_3)_2PO_4]_6$ per 100 gms. H_2O
0	6.44
25	3.53
50	1.90

YTTRIUM SULFATE $Y_2(SO_4)_3$.

SOLUBILITY OF YTTRIUM SULFATE IN WATER. (Crew, Steinert and Hopkins, 1925.)

t°	Gms. $Y_2(SO_4)_3$ per 100 gms. H_2O	t°	Gms. $Y_2(SO_4)_3$ per 100 gms. H_2O
3.6.....	7.94	50.0.....	5.37
15.8.....	7.49	75.0.....	3.22
25.0.....	7.20	95.0.....	2.03

100 gms. H_2O dissolve 9.764 gms. $Y_2(SO_4)_3 \cdot 8H_2O$ at 20° and 4.9 gms. at 40° . (Jackson and Rienacker, 1930.)

YTTRIUM SULFATE $Y_2(SO_4)_3$.

SOLUBILITY OF YTTRIUM SULFATE IN AQUEOUS SOLUTIONS OF SODIUM SULFATE AT 25° . (James and Holden, 1913.)

Equilibrium was reached very slowly and it was necessary to rotate the mixtures for 14 months before final equilibrium was reached.

Gms. per 100 Gms. H_2O		Solid Phase.	Gms. per 100 Gms. H_2O		Solid Phase.
$Y_2(SO_4)_3$	Na_2SO_4		$Y_2(SO_4)_3$	Na_2SO_4	
5.61	1.29	$Y_2(SO_4)_3$	1.90	14.89	$Y_2(SO_4)_3 \cdot Na_2SO_4 \cdot 2H_2O$
6.38	3.85	"	1.79	16.51	"
7.40	6.21	"	1.86	18.44	"
8.43	8.53	" + $Y_2(SO_4)_3 \cdot Na_2SO_4 \cdot 2H_2O$	2.99	19.96	"
5.86	7.57	$Y_2(SO_4)_3 \cdot Na_2SO_4 \cdot 2H_2O$	3.04	21.05	"
4.75	7.72	"	2.27	27.14	"
3.42	10.14	"	1.52	28.22	"
2.36	11.36	"	1.61	28.13	"
2.02	13.42	"	5.38	0	$Na_2SO_4 \cdot 10H_2O$

YTTERBIUM CobaltiCYANIDE $\text{Yb}_2(\text{CoC}_6\text{N}_6)_2 \cdot 9\text{H}_2\text{O}$.

1000 gms. aqueous 10% HCl ($d_{15} = 1.05$) dissolve 0.38 gm. of the salt at 25°. (James and Willand, 1916.)

YTTERBIUM OXALATE $\text{Yb}_2(\text{C}_2\text{O}_4)_3 \cdot 10\text{H}_2\text{O}$.

SOLUBILITY IN WATER AND IN SEVERAL AQUEOUS SOLUTIONS.

Aqueous Solution of:	Per cent Conc. of Aq. Sol.	t°.	Gms. $\text{Yb}_2(\text{C}_2\text{O}_4)_3$ per 100 cc. Solvent.	Authority.
Water	...	25	0.000334	(Rimbach and Schubert, 1909.)
$(\text{NH}_4)_2\text{C}_2\text{O}_4 \cdot \text{H}_2\text{O}$	3.26	ord.	0.095	(Cleve, 1902.)
Methylamine Oxalate	20	"	5.24*	(Grant and James, 1917.)
Ethylamine Oxalate	20	"	5.86*	"
Triethylamine Oxalate	20	"	2.05*	"
Sulfuric Acid (1 n)	4.9	"	0.372	(Cleve, 1902.)

* The authors do not state whether their figures are for anhydrous or hydrated salt.

YTTERBIUM CHLORIDE $\text{YbCl}_3 \cdot 6\text{H}_2\text{O}$.

SOLUBILITY OF YTTERBIUM CHLORIDE IN AQUEOUS HYDROCHLORIC ACID OF DENSITY 1.1051. (Williams, Fogg and James, 1925.)

Constant rotation in a thermostat for 9 hours and approaching equilibrium from above and below was employed.

Cl

t°.	Gms. YbCl_3 per 100 gms. sat. sol.	Solid Phase.	t°.	Gms. YbCl_3 per 100 gms. sat. sol.	Solid Phase.
10.....	32.00	$\text{YbCl}_3 \cdot 6\text{H}_2\text{O}$	40.....	33.84	$\text{YbCl}_3 \cdot 6\text{H}_2\text{O}$
20.....	32.38	"	50.....	34.88	"
30.....	33.03	"			

YTTERBIUM Dimethyl PHOSPHATE $\text{Yb}_2[(\text{CH}_3)_2\text{PO}_4]_6$.

100 gms. H_2O dissolve 1.2 gms. $\text{Yb}_2[(\text{CH}_3)_2\text{PO}_4]_6$ at 25° and 0.25 gm. at 95°. (Morgan and James, 1914.)

The following results differing from the above are by Marsh, 1939.

t°	Gms. $\text{Yb}_2[(\text{CH}_3)_2\text{P}^{\text{O}}_4]_6$
0	2.68
25	1.35
50	0.72

YTTERBIUM SULFATE $\text{Yb}_2(\text{SO}_4)_3 \cdot 8\text{H}_2\text{O}$.

SOLUBILITY IN WATER.
(Cleve, 1902.)

t°.	Gms. $\text{Yb}_2(\text{SO}_4)_3$ per 100 gms. H_2O .	t°.	Gms. $\text{Yb}_2(\text{SO}_4)_3$ per 100 Gms. H_2O .	t°.	Gms. $\text{Yb}_2(\text{SO}_4)_3$ per 100 Gms. H_2O .
0	44.2	55	11.5	80	6.92
15.5	34.6	60	10.4	90	5.83
35	19.1	70	7.22	100	4.67

100 gms. H_2O dissolve 34.78 gms. $\text{Yb}_2(\text{SO}_4)_3 \cdot 8\text{H}_2\text{O}$ at 20° and 22.9 gms. at 40°. (Jackson and Rienacker, 1930.)

YTTERBIUM Bromonitrobenzene SULFONATE $\text{Yb}(\text{C}_6\text{H}_3\text{Br} \cdot \text{NO}_2 \cdot \text{SO}_3, 1.4.3)_{12} \cdot 12\text{H}_2\text{O}$.

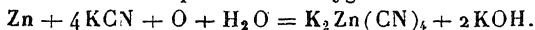
100 gms. sat. solution in water contain 7.294 gms. of the anhydrous salt at 25°. (Katz and James, 1913.)

SO

ZINC Zn.

SOLUBILITY OF ZINC IN AQUEOUS POTASSIUM CYANIDE SOLUTIONS. (White, 1919.)

The weight of zinc dissolved per 24 hours from rectangular (2.5×1.5 cm.) pieces of ordinary commercial rolled sheet zinc 0.03 mm. in thickness, when suspended in aqueous potassium cyanide solutions, was determined. Uniform conditions were maintained in each experiment but the temperature was not held constant. The influence of oxygen concentration, cyanide concentration, alkalinity, etc. was studied. The main reaction in presence of oxygen is



Therefore, 6.6 milligrams of oxygen per liter is equivalent to 0.0089 per cent KCN and to 24.5 milligrams of Zn per liter. However, in the absence of oxygen some zinc may dissolve. Numerous tables and curves are given.

SOLUBILITY OF ZINC IN MILK.

(Quam, 1929.)

Highly polished 4×7.5 cm. strips of zinc were each immersed in 50 cc portions of raw milk and rocked 46 times per minute for 30 minutes. The loss in weight of the Zn strips was determined and the result expressed in mgs. Zn dissolved per sq. decimeter of surface exposed.

t°	Mgs. Zn dissolved per sq. dm.	t°	Mgs. Zn dissolved per sq. dm.
30	0.432	75	1.78
40	0.744	85	1.546
50	1.03	95	1.03
60	1.546		

ZINC ARSENITE $\text{Zn}_3(\text{AsO}_3)_2$.

100 gms. 95% formic acid dissolve 0.36 gm. $\text{Zn}_3(\text{AsO}_3)_2$ at 21°. (Aschan, 1913.)

ZINC ARSENATE $\text{Zn}_3(\text{AsO}_4)_2 \cdot 8\text{H}_2\text{O}$.

100 gms. 95% formic acid dissolve 0.26 gm. $\text{Zn}_3(\text{AsO}_4)_2$ at 21°. (Aschan, 1913.)

ZINC BROMIDE $\text{ZnBr}_2 \cdot 2\text{H}_2\text{O}$.**SOLUBILITY IN WATER.**

(Dietz, 1900; see also Etard, 1894.)

t°.	Gms. ZnBr ₂ per 100 Gms. Solution.	Mols. ZnBr ₂ per 100 Mols. H ₂ O.	Solid Phase.	t°.	Gms. ZnBr ₂ per 100 Gms. Solution.	Mols. ZnBr ₂ per 100 Mols. H ₂ O.	Solid Phase.
-15	77.13	27.0	$\text{ZnBr}_2 \cdot 3\text{H}_2\text{O}$	25	82.46	37.6	$\text{ZnBr}_2 \cdot 2\text{H}_2\text{O}$
-10	78.45	29.1	"	30	84.08	42.3	"
-5	80.64	33.3	"	37	86.20	50.0	"
-8	79.06	30.2	$\text{ZnBr}_2 \cdot 2\text{H}_2\text{O}$	35	85.45	46.9	ZnBr_2
0	79.55	31.1	"	40	85.53	47.4	"
+13	80.76	33.5	"	60	86.08	49.5	"
18	81.46	35.1	"	80	86.57	51.5	"
				100	87.05	53.8	"

The transition point of $\text{ZnBr}_2 \cdot 2\text{H}_2\text{O} \rightarrow \text{ZnBr}_2$ is given as 35° by Ishikawa and Yoshida, 1930.

SOLUBILITY OF ANHYDROUS ZINC BROMIDE IN PURE ACETONE.

(Bell, Rowlands, Bamford, Thomas and Jones, 1930.)

t°	Gms. ZnBr_2 per 100 gms. $(\text{CH}_3)_2\text{CO}$	Solid Phase
20	364.0	$\text{ZnBr}_2 \cdot \frac{1}{2}(\text{CH}_3)_2\text{CO}$
30	363.0	"
31 tr.pt.	—	" + ZnBr_2
40	380.0	ZnBr_2
50	381.0	"

Br 100 cc Pyridine dissolve 4.4 gms. ZnBr_2 at 18° . (Müller, R., 1924.)

ZINC CACODYLATE $\text{Zn}[(\text{CH}_3)_2\text{AsOO}]_2 \cdot 7\text{H}_2\text{O}$.

SOLUBILITY OF ZINC CACODYLATE IN WATER.

(Tiollais and Perdreau, 1939.)

t°	Gms. $\text{Zn}[(\text{CH}_3)_2\text{AsOO}]_2$ per 100 gms. sat. sol.	Solid Phase	t°	Gms. $\text{Zn}[(\text{CH}_3)_2\text{AsOO}]_2$ per 100 gms. sat. sol.	Solid Phase
1	25.9	$\text{Zn}[(\text{CH}_3)_2\text{AsOO}]_2 \cdot 7\text{H}_2\text{O}$	34	35.5	$\text{Zn}[(\text{CH}_3)_2\text{AsOO}]_2 \cdot \text{H}_2\text{O}$
8	28.0	"	42	34.2	"
21	33.2	"	56	34.0	"
23	36.5	"	64	34.3	$\text{Zn}[(\text{CH}_3)_2\text{AsOO}]_2$
25	40.0	" + $\text{Zn}[(\text{CH}_3)_2\text{AsOO}]_2 \cdot \text{H}_2\text{O}$	72	36.0	"
27.5	38.1	$\text{Zn}[(\text{CH}_3)_2\text{AsOO}]_2 \cdot \text{H}_2\text{O}$	84	39.2	"
30	36.5	"	98	44.2	"

These authors also give similar results for the solubility of Cadmium Cacodylate in Water.

CH ZINC FORMATE $\text{Zn}(\text{HCOO})_2 \cdot 2\text{H}_2\text{O}$.

SOLUBILITY OF ZINC FORMATE IN WATER.

(Ashton, Houston and Saylor, 1933.)

t°	Gms. $\text{Zn}(\text{HCOO})_2$ per 100 gms. H_2O	Solid Phase	t°	Gms. $\text{Zn}(\text{HCOO})_2$ per 100 gms. H_2O	Solid Phase
0	3.7	$\text{Zn}(\text{HCOO})_2 \cdot 2\text{H}_2\text{O}$	60	11.8	$\text{Zn}(\text{HCOO})_2 \cdot 2\text{H}_2\text{O}$
10	4.3	"	70	15.5	"
20	5.2	"	80	21.2	"
30	6.1	"	90	28.8	"
40	7.4	"	100	38.0	"
50	9.2	"			

ZINC ACETATE $\text{Zn}(\text{C}_2\text{H}_3\text{O}_2)_2 \cdot 2\text{H}_2\text{O}$.

SOLUBILITY IN AQUEOUS ETHYL ALCOHOL AT 25°. (Seidell, 1910.)

Wt. % $\text{C}_2\text{H}_5\text{OH}$ in Solvent.	d_{25} of Sat. Sol.	Gms. Zn- $(\text{C}_2\text{H}_3\text{O}_2)_2 \cdot 2\text{H}_2\text{O}$ per 100 Gms. Sat. Sol.	Wt. % $\text{C}_2\text{H}_5\text{OH}$ in Solvent.	d_{25} of Sat. Sol.	Gms. Zn- $(\text{C}_2\text{H}_3\text{O}_2)_2 \cdot 2\text{H}_2\text{O}$ per 100 Gms. Sat. Sol.
0	1.168	30.80	60	0.920	10.60
10	1.127	27.20	70	0.880	7.80
20	1.090	23.70	80	0.850	5.50
30	1.055	20.40	90	0.830	4.20
40	1.015	17	95	0.825	4
50	0.970	13.80	100	0.796	1.18*

* = gms. anhydrous salt. The solid phase was $\text{Zn}(\text{C}_2\text{H}_3\text{O}_2)_2 \cdot 2\text{H}_2\text{O}$ in all cases except this solution.100 gms. H_2O dissolve 41.6 gms. $\text{Zn}(\text{C}_2\text{H}_3\text{O}_2)_2 \cdot \text{H}_2\text{O}$ at 15°, d of sat. sol. = 1.165. (Greenish and Smith, 1902.)

100 cc. anhydrous hydrazine dissolve 4 gms. zinc acetate with separation of a white suspension at ordinary temperature. (Welsh and Broderson, 1915.)

100 gms. Methyl Alcohol dissolve 1.9 gm. anhydrous Zinc Acetate at 15° and 1.9 gms. at 66.6° (b.pt.). (Henstock, 1934.)

SOLUBILITY OF ZINC ACETATE IN PURE ACETIC ACID.

(Davidson and McAllister, 1930.)

t°	Mol. Percentage Zn $(\text{CH}_3\text{COO})_2$ in sat. sol.	Solid Phase	t°	Mol. Percentage Zn $(\text{CH}_3\text{COO})_2$ in sat. sol.	Solid Phase	CH
40.5	0.0050	$\text{Zn}(\text{CH}_3\text{COO})_2$	56	0.0150	$\text{Zn}(\text{CH}_3\text{COO})_2$	
43	0.0054	"	62	0.0231	"	
48	0.0085	"	72	0.0382	"	
52	0.0109	"				

Results are also given for the ternary system $\text{Zn}(\text{CH}_3\text{COO})_2 + \text{NaCH}_3\text{COO} + \text{CH}_3\text{COOH}$.Results for the ternary system $\text{Zn}(\text{CH}_3\text{COO})_2 + \text{NH}_4\text{CH}_3\text{COO} + \text{CH}_3\text{COOH}$ are given by Davidson and Griswold, 1935.Results for the ternary system $\text{Zn}(\text{CH}_3\text{COO})_2 + \text{ZnCl}_2 + \text{CH}_3\text{COOH}$ are given by Davidson and Chappell, 1939.**ZINC FUMARATE** $\text{ZnC}_4\text{H}_2\text{O}_4 \cdot 1.5\text{H}_2\text{O}$.100 gms. H_2O dissolve 1.96 gms. of the compound at 30°. The sat. solution was analyzed by evaporating to dryness and drying the residue at 100°. The result, therefore, probably refers to the anhydrous compound. (Weiss and Downs, 1923.)**ZINC TARTRATE** $\text{C}_4\text{H}_4\text{O}_6 \cdot \text{Zn} \cdot 2\text{H}_2\text{O}$.SOLUBILITY IN WATER.
(Cantoni and Zachoder, 1905.)

t°	Gms. $\text{C}_4\text{H}_4\text{O}_6 \cdot \text{Zn} \cdot 2\text{H}_2\text{O}$ per 100 cc. Solution.	t°	Gms. $\text{C}_4\text{H}_4\text{O}_6 \cdot \text{Zn} \cdot 2\text{H}_2\text{O}$ per 100 cc. Solution.	t°	Gms. $\text{C}_4\text{H}_4\text{O}_6 \cdot \text{Zn} \cdot 2\text{H}_2\text{O}$ per 100 cc. Solution.
15	0.019	40	0.060	65	0.100
20	0.022	45	0.073	70	0.088
25	0.036	50	0.087	75	0.078
30	0.041	55	0.116	80	0.059
35	0.055	60	0.104	85	0.041

ZINC VALERATE $\text{Zn}(\text{C}_4\text{H}_9\text{COO})_2 \cdot 2\text{H}_2\text{O}$.

SOLUBILITY OF ZINC VALERATE IN AQUEOUS ALCOHOL SOLUTIONS AT 25°.
(Seidell, 1910.)

Wt. % $\text{C}_2\text{H}_5\text{OH}$ in Solvent.	d_{25} of Sat. Sol.	Gms. $\text{Zn}(\text{C}_4\text{H}_9\text{COO})_2 \cdot 2\text{H}_2\text{O}$ per 100 Gms. Sat. Sol.	Wt. % $\text{C}_2\text{H}_5\text{OH}$ in Solvent.	d_{25} of Sat. Sol.	Gms. $\text{Zn}(\text{C}_4\text{H}_9\text{COO})_2 \cdot 2\text{H}_2\text{O}$ per 100 Gms. Sat. Sol.
0	1.004	1.44	85	0.836	2.15
20	0.972	0.75	90	0.827	3.20
40	0.936	0.76	92.3	0.828	5.50
60	0.894	1.15	95	0.832	8.80
80	0.848	1.70	100	0.844	15.60

ZINC GLUCONATE $\text{Zn}(\text{C}_6\text{H}_{11}\text{O}_7)_2 \cdot 3\text{H}_2\text{O}$.

100 cc sat. solution of Zinc Gluconate in Water contain 12.7 gms.
 $\text{Zn}(\text{C}_6\text{H}_{11}\text{O}_7)_2$ at 25°. (May, Weisberg and Herrick, 1929.)

23

25

27.5

ZINC BENZOATE $\text{Zn}(\text{C}_7\text{H}_5\text{O}_2)_2$.

SOLUBILITY IN WATER.

(Pajetta, 1906.)

t°	15.9°	17°	27.8°	31.3°	37.5°	49.8°	59°
Gms. $\text{Zn}(\text{C}_7\text{H}_5\text{O}_2)_2$ per 100 gms. aq. solution	2.55	2.49	2.41	2.05	1.87	1.62	1.45

SOLUBILITY OF ZINC BENZOATE IN SEVERAL SOLVENTS.

(Henstock, 1934.)

CH

Solvent	t°	Gms. $\text{Zn}(\text{C}_6\text{H}_5\text{COO})_2$ per 100 gms. solvent
Methyl Alcohol	15	9.90
" "	65.9 (b.pt.)	6.62
Acetone	15	1.00
Benzene	15	4.20

ZINC BENZOATE Chloro, Nitro, etc., **BENZOATES**.

SOLUBILITY OF EACH SEPARATELY IN WATER AT 20°. (Ephraim and Pfister, 1925.)

Compound.	Formula.	Gms. anhydrous compound per 100 cc. sat. sol.
Zinc Benzoate.....	$\text{Zn}(\text{C}_6\text{H}_5\text{COO})_2 \cdot \text{H}_2\text{O}$	2.048
" 4-Chloro Benzoate....	$\text{Zn}(\text{C}_6\text{H}_4\text{ClCOO})_2 \cdot 2\text{H}_2\text{O}$	0.649
" 4-Methoxy "	$\text{Zn}(\text{C}_6\text{H}_4\text{OCH}_3\text{COO})_2 \cdot \text{H}_2\text{O}$..	1.174
" 4-Nitro... "	$\text{Zn}(\text{C}_6\text{H}_4\text{NO}_2\text{COO})_2 \cdot 2\text{H}_2\text{O}$..	0.556
" 4-Oxy.... "	$\text{Zn}(\text{C}_6\text{H}_4\text{OHCOO})_2 \cdot 8\text{H}_2\text{O}$...	1.687

ZINC Nitroso β PHENYL HYDROXYLAMINE $\text{Zn}[\text{C}_6\text{H}_5\text{N}(\text{NO})\text{O}]_2$.

One liter sat. solution in Water contains 0.00049 gm. at. = 0.032 gm Zn
at 18°. (Pinkus and Martin, 1927.)

ZINC CINNAMATE $\text{Zn C}_{18}\text{H}_{14}\text{O}_4 \cdot 2\text{H}_2\text{O}$.

100 cc. sat. solution of zinc cinnamate in water contain 0.15 gm. $\text{Zn C}_{18}\text{H}_{14}\text{O}_4$
at 20°. (Ephraim, and Pfister, 1925.)

100 cc. sat. solution in water contain 0.144 gm. zinc cinnamate at 26.5°.

(De Jong, 1909.)

ZINC SULFONATES

SOLUBILITY IN WATER.

Name.	Formula.	t°.	Gms. Anhy. Salt per 100 Gms. H ₂ O.	Authority.
Zinc β Naphthalene Sulfonate	(C ₁₀ H ₇ .SO ₃) ₂ Zn.6H ₂ O	25	0.45	(Witt, 1915.)
Zinc 2-Phenanthrene "	(C ₁₄ H ₉ .SO ₃) ₂ Zn.6H ₂ O	20	0.083	(Sandquist, '12.)
" 3- "	(C ₁₄ H ₉ .SO ₃) ₂ Zn.4H ₂ O	20	0.19	"
" 10- "	(C ₁₄ H ₉ .SO ₃) ₂ Zn.6H ₂ O	20	0.15	"

ZINC Benzene and Naphthalene SULFONATES.

SOLUBILITY OF EACH SEPARATELY IN WATER. (Ephraim and Seger, 1925.)

Results for Zinc Benzene sulfonate.

Results for Zinc Naphthalene-2-sulfonate.

t°.	Gms. Zn(C ₆ H ₅ SO ₃) ₂ per 100 cc. sat. sol.	Solid Phase.	t°.	Gms. Zn(C ₁₀ H ₇ SO ₃) ₂ per 100 cc. sat. sol.	Solid Phase.
10.0.....	14.769	Zn(C ₆ H ₅ SO ₃) ₂ .6H ₂ O	20.....	0.487	Zn(C ₁₀ H ₇ SO ₃) ₂ .6H ₂ O
34.0.....	19.107	"	32.....	0.579	"
49.5.....	24.705	"	45.....	0.853	"
64.5.....	32.018	"	54.5.....	1.218	"
80.5.....	40.685	"	65.....	1.690	"
82.0.....	41.014	"	76.5.....	2.512	"
			82.....	3.130	"

CH

SOLUBILITY OF SEVERAL ZINC SULFONATES IN WATER.

Compound.	Formula.	t°.	Gms. anhydrous cnpd. per 100 cc. sat. sol.
Zinc Anthracene-1-sulfonate...	Zn(C ₁₄ H ₉ SO ₃) ₂ .6H ₂ O	20	0.05 (1)
" " -2- " ...	Zn(C ₁₄ H ₉ SO ₃) ₂ .6H ₂ O	20	0.00741 (1)
" Naphthalene-1- " ...	Zn(C ₁₀ H ₇ SO ₃) ₂ .6H ₂ O	17	0.659 (2)
" " -6- oxy -2- " ...	Zn(C ₁₀ H ₇ SO ₃) ₂ .8H ₂ O	20	0.874 (1)
" " -5-chlor -1- " ...	Zn(C ₁₀ H ₆ ClSO ₃) ₂ .4H ₂ O	20	1.205 (1)
" -2.6.8- { Naphthylamine di- }	Zn C ₁₀ H ₅ NH ₂ (SO ₃) ₂ {	15	34.5 * (3)
" -2.5.7- { sulfonate..... }		15	39.4 * (3)

(1) Ephraim and Pfister, 1925a. (2) Ephraim and Seger, 1925. (3) Braunschweig, 1922, 1926.

* These results are in terms of grams per 100 grams of the saturated solution instead of gms. per 100 cc. sat. solution.

SOLUBILITY OF ZINC PHENOLSULFONATE, *p* (C₆H₄.OH.SO₃)₂Zn.8H₂O, IN AQUEOUS ALCOHOL SOLUTIONS AT 25°.

(Seidell, 1910.)

Wt. % C ₂ H ₅ OH in Solvent.	d ₂₅ of Sat. Sol.	Gms. (C ₆ H ₄ .OH. SO ₃) ₂ Zn.8H ₂ O per 100 Gms. Sat. Sol.	Wt. % C ₂ H ₅ OH in Solvent.	d ₂₅ of Sat. Sol.	Gms. (C ₆ H ₄ .OH. SO ₃) ₂ Zn.8H ₂ O per 100 Gms. Sat. Sol.
0	1.185	39.8	80	1.057	40.7
20	1.161	40.7	90	1.047	41.4
40	1.139	42.1	92.3	1.048	41.9
47	...	42.2	95	1.052	42.9
60	1.106	41.6	100	1.075	48.8

100 gms. H₂O dissolve 37 gms. (C₆H₄.OH.SO₃)₂Zn.8H₂O at 15° and d₁₅ of sat. sol. = 1.162. (Greenish and Smith, 1902.)ZINC HELIANTHATE Zn(C₁₄H₁₄N₃SO₃)₂.4H₂O.1000 cc. H₂O dissolve 0.098 gm. of the hydrated salt at 20-25°.

(Stark and Dehn, 1918.)

ZINC CYANIDE $\text{Zn}(\text{CN})_2$.

One liter sat. solution of zinc cyanide in water contains 0.000049 gm. mol. $\text{Zn}(\text{CN})_2$ at 18° , as determined by E.M.F. measurements. (Masaki, 1931.)

100 cc. concentrated $\text{Zn}(\text{C}_2\text{H}_3\text{O}_2)_2$ + Aq. dissolve 0.4 gm. $\text{Zn}(\text{CN})_2$.

100 cc. concentrated ZnSO_4 + Aq. dissolve 0.2 gm. (Joannis, 1882.)

100 gms. H_2O dissolve 0.24 gm. zinc mercuric thiocyanate, $\text{ZnHg}(\text{CNS})_4$ at 15° .

(Robertson, P. W., 1907.)

ZINC THIOCYANATE $\text{Zn}(\text{SCN})_2$.

One liter sat. solution of zinc thiocyanate in water contains 0.144 gm. mol. $\text{Zn}(\text{SCN})_2$ at 18° , as determined by E.M.F. measurements. (Masaki, 1931.)

100 gms. Liquid Sulfur Dioxide dissolve 0.73 gm. $\text{Zn}(\text{SCN})_2$ at 0° . (Jander and Ruppolt, 1937.)

ZINC CARBONATE Zn CO_3 .

100 gms. of a sat. solution of Zn CO_3 in water at 18° and in contact with CO_2 at a pressure of 1 atmosphere contain 0.07 gm. Zn CO_3 . At a pressure of 56 atmospheres of CO_2 0.084 gm. Zn CO_3 are dissolved. (Hachuel, 1924.)

Agono and Valla (1911) report that the solubility of ZnCO_3 in water at 25° is $1.64 \cdot 10^{-4}$ mols. = 0.206 gm. per liter.

One liter of aq. 5.85% NaCl solution dissolves 0.0586 gm. ZnCO_3 at 14° .

One liter of aq. 7.45% NaCl solution dissolves 0.0477 gm. ZnCO_3 at 14° .

(Cantoni and Passamanik, 1905.)

CO

ZINC BICARBONATE $\text{Zn}(\text{HCO}_3)_2$.

SOLUBILITY OF ZINC BICARBONATE IN WATER CONTAINING CARBON DIOXIDE.
(Smith, 1918.)

For description of the experimental method see iron bicarbonate, p. 336.

Atmospheres Pressure of CO_2 , Calc. by Henry's Law.	Results at 25° .		Results at 30° .	
	Gm. Mols. Free H_2CO_3 per Liter.	Gm. Mols. $\text{Zn}(\text{HCO}_3)_2$ per Liter.	Gm. Mols. Free H_2CO_3 per Liter.	Gm. Mols. $\text{Zn}(\text{HCO}_3)_2$ per Liter.
4.12	0.1390	0.00194	0.1838	0.00215
5.33	0.1797	0.00211	0.3838	0.00277
7.64	0.2579	0.00242	0.4038	0.00286
10.61	0.3580	0.00270	0.4601	0.00308
12.16	0.4103	0.00278	0.6064	0.00324
13.29	0.4480	0.00291	0.6257	0.00337
19.73	0.6657	0.00317	0.7470	0.00352
20.65	0.6969	0.00319	0.8351	0.00376
22.56	0.7610	0.00343	1.0840	0.00339
40.61	1.3701	0.00445	1.1275	0.00429

The calculated pressures are lower than the actual pressures since Henry's Law does not hold at very high pressures.

"If zinc carbonate were not hydrolytically dissociated, its solubility in pure water at 25° , would be 4.58×10^{-6} gms. mols. per liter." (Smith, 1918.)

ZINC Campho CARBONATE $\text{Zn}(\text{C}_{11}\text{H}_{15}\text{O}_3)_2$.

SOLUBILITY OF ZINC CAMPHO CARBONATE IN SEVERAL SOLVENTS AT 10° .
(Picon, 1931.)

Solvent	Gms. $\text{Zn}(\text{C}_{11}\text{H}_{15}\text{O}_3)_2$ per liter sat. sol.
Water	4.0
Petroleum	373.3
Acetone	281.0
Olive oil	125.0 (15°)

When the compound is dissolved in boiling benzene and is then separated from this solvent and thus completely dehydrated, it becomes soluble to the extent of 500 gms. per liter in methyl alcohol, ethyl alcohol, benzene, chloroform, carbon tetrachloride, carbon disulfide and petroleum ether.

ZINC OXALATE $\text{ZnC}_2\text{O}_4 \cdot 2\text{H}_2\text{O}$.

One liter H_2O dissolves 0.0057 gm. ZnC_2O_4 at 9.76° , 0.0064 gm. at 17.92° and 0.00715 gm. at 26.15° . (Kohlrausch, 1908.)

One liter sat. solution of $\text{ZnC}_2\text{O}_4 \cdot 2\text{H}_2\text{O}$ in Water contains 0.0209 gm. ZnC_2O_4 at 18° . (Scholder, Gadenne and Nie mann, 1927.)

SOLUBILITY OF ZINC OXALATE IN AQUEOUS SOLUTIONS OF SULFURIC ACID AT 18° .
(Britton and Jarrett, 1936.)

Gm. Mols. per liter		Gm. Mols. per liter	
H_2SO_4	ZnC_2O_4	H_2SO_4	ZnC_2O_4
0.05	0.000445	1.00	0.003901
0.125	0.000737	1.50	0.005550
0.25	0.001395	1.875	0.006695
0.50	0.002178		

SOLUBILITY OF ZINC OXALATE IN AQUEOUS AMMONIUM OXALATE SOLUTIONS AT 25° .
(Kunschert, 1904.)

Mol. Normal $(\text{NH}_4)_2\text{C}_2\text{O}_4$	0.05	0.10	0.15	0.20	0.25
Mol. Zn per Liter	0.0022	0.0055	0.01055	0.0174	0.0257

Complex ammonia zinc oxalates are formed. When more than 0.15 free oxalate is present the complex has the formula, $(\text{NH}_4)_4\text{Zn}(\text{C}_2\text{O}_4)_3$. In the more dilute solutions it has the composition, $(\text{NH}_4)_2\text{Zn}(\text{C}_2\text{O}_4)_2$.

SOLUBILITY OF ZINC OXALATE AT 25° IN AQUEOUS SOLUTIONS OF:
(Clayton and Wosburgh, 1937.)

Cadmium Sulfate

Potassium Oxalate

Mols. per 1000 gms. H_2O	
CdSO_4	ZnC_2O_4
0.0	0.000168
0.005	0.000145
0.010	0.000202
0.020	0.000226
0.040	0.000386
0.080	0.000645

Mols. per 1000 gms. H_2O	
Total Oxalate	ZnC_2O_4
0.0100	0.000460
0.02745	0.001030
0.04841	0.001803
0.1116	0.006480

ZINC CHLORIDE ZnCl_2 .

SOLUBILITY IN WATER.

(Mylilius and Dietz, 1905; see also Dietz, 1900; Etard, 1894.)

t°.	Gms. ZnCl_2 per 100 Gms.		Solid Phase.	t°.	Gms. ZnCl_2 per 100 Gms.		Solid Phase.
	Water.	Solution.			Water.	Solution.	
-5	14	12.3	Ice	9	360	78.3	$.2\frac{1}{2}\text{H}_2\text{O} + .\text{H}_2\text{O}$
-10	25	20.0	"	6	385	79.4	$\text{ZnCl}_2 \cdot 2\frac{1}{2}\text{H}_2\text{O}$
-40	83	45.3	"	6	298	74.9	$\text{ZnCl}_2 \cdot 1\frac{1}{2}\text{H}_2\text{O}$
-62	104	51.0	$\text{Ice} + \text{ZnCl}_2 \cdot 4\text{H}_2\text{O}$	10	330	76.8	"
-50	113	53.0	$\text{ZnCl}_2 \cdot 4\text{H}_2\text{O}$	20	368	78.6	"
-40	127	55.9	"	26	423	80.9	$.1\frac{1}{2}\text{H}_2\text{O} + \text{ZnCl}_2 \cdot \text{H}_2\text{O}$
-30	160	61.5	$.4\text{H}_2\text{O} + .3\text{H}_2\text{O}$	26.3	433	81.2	$.1\frac{1}{2}\text{H}_2\text{O} + \text{ZnCl}_2$
-10	189	65.4	$\text{ZnCl}_2 \cdot 3\text{H}_2\text{O}$	0	342	77.4	$\text{ZnCl}_2 \cdot \text{H}_2\text{O}$
0	208	67.5	"	10	364	78.4	"
+5	230	69.7	"	20	396	79.8	"
6.5	252.4	71.6	"	28	436	81.3	$\text{ZnCl}_2 \cdot \text{H}_2\text{O} + \text{ZnCl}_2$
5	282	73.8	"	31	477	82.7	$\text{ZnCl}_2 \cdot \text{H}_2\text{O}$
0	309	75.5	$.3\text{H}_2\text{O} + .1\frac{1}{2}\text{H}_2\text{O}$	25	432	81.2	ZnCl_2
0	235	70.1	$\text{ZnCl}_2 \cdot 2\frac{1}{2}\text{H}_2\text{O}$	40	452	81.9	"
6.5	252	71.6	$.2\frac{1}{2}\text{H}_2\text{O} + .3\text{H}_2\text{O}$	60	488	83.0	"
10	272	73.1	$\text{ZnCl}_2 \cdot 2\frac{1}{2}\text{H}_2\text{O}$	80	543	84.4	"
12.5	303	75.2	"	100	615	86.0	"
11.5	335	77.0	$.2\frac{1}{2}\text{H}_2\text{O} + .1\frac{1}{2}\text{H}_2\text{O}$	262	∞	100.0	"

Cl

SOLUBILITY OF OXYCHLORIDES OF ZINC IN AQUEOUS SOLUTIONS OF ZINC CHLORIDE AT ROOM TEMPERATURE.

(Driot, 1910.)

Gms. per 100 Gms. H_2O .		Solid Phase.	Gms. per 100 Gms. H_2O .		Solid Phase.
ZnCl_2 .	ZnO .		ZnCl_2 .	ZnO .	
8.22	0.0137	$\text{ZnCl}_2 \cdot 4\text{ZnO} \cdot 6\text{H}_2\text{O}$	62.85	0.884	$\text{ZnCl}_2 \cdot 4\text{ZnO} \cdot 6\text{H}_2\text{O}$
23.24	0.138	"	96	1.792	"
45.95	0.497	"	124.7	3.213	"
51.5	0.604	"	144.8	2.64	"
56.9	0.723	"	203	1.59	$\text{ZnCl}_2 \cdot \text{ZnO} \cdot 1\frac{1}{2}\text{H}_2\text{O}$

Results are also given for mixture of the oxychloride and oxide in aqueous zinc chloride solutions at various temperatures.

Data for equilibrium in the system Zinc Chloride, Zinc Oxide and Water at 25° and at 50° are given by Holland, 1930. The results are presented according to Jánecke's method and can only be converted to the weight basis by tedious calculations. The author failed to find the compound $\text{ZnCl}_2 \cdot \text{ZnO} \cdot 1\frac{1}{2}\text{H}_2\text{O}$ reported by Driot. He obtained evidence for the existence of two new oxychlorides of zinc, namely, $\text{ZnCl}_2 \cdot \text{ZnO} \cdot 2\frac{1}{2}\text{H}_2\text{O}$ and $\text{ZnCl}_2 \cdot \text{ZnO} \cdot \text{H}_2\text{O}$. Of those formerly described only $\text{ZnCl}_2 \cdot 5\text{ZnO} \cdot 8\text{H}_2\text{O}$ exists in stable equilibrium in the range of concentration of the present experiments.

Additional data on this system are given by Feitknecht, 1930. The results which are given only in the form of a diagram are in satisfactory agreement with those of Driot. In addition to the solubility of ZnO in aqueous solutions of ZnCl_2 the author also gives curves showing the solubility of ZnO in aqueous solutions of ZnBr_2 and of ZnI_2 .

EQUILIBRIUM IN THE SYSTEM ZINC CHLORIDE AND ACETIC ACID.
DETERMINED BY THE FREEZING-POINT METHOD.

(Davidson and Chappell, 1939.)

t°	Mol. percent ZnCl ₂ in Mixture	Solid Phase	t°	Mol. Percent ZnCl ₂ in Mixture	Solid Phase
16.6	0.0	CH ₃ COOH	10.35	10.99	CH ₃ COOH
15.75	1.77	"	8.55	12.88	"
14.95	3.46	"	7.30	14.14	"
12.85	7.31	"	4.80	16.16	"
11.45	9.67	"	2.0	18.45	"
			-4.0	22.07	"

The authors also give results for the system Zinc Chloride + Zinc Acetate + Acetic Acid.

100 gms. abs. acetone dissolve 43.5 gms. ZnCl₂ at 18°, d₁₈ of sat. sol. = 1.14.

(Naumann, 1904.)

100 gms. glycerol dissolve 50 gms. ZnCl₂ at 15.5°.

(Ossendowski, 1907.)

100 cc. anhydrous hydrazine dissolve 8 gms. ZnCl₂ at room temp.

(Welsh and Brodersen, 1915.)

When 1 gm. of zinc as chloride is dissolved in 100 cc. of aq. 10% HCl and shaken with 100 cc. of ether, 0.03 per cent of the metal enters the ethereal layer.

(Mylius, 1911.)

Cl

ZINC CHLORIDE Zn Cl₂.

SOLUBILITY OF ZINC CHLORIDE IN PYRIDINE. (Mason and Mathews, 1925.)

The determinations were made with a modified Meyerhoffer-Saunders apparatus (Walton and Judd, *J. Am. Chem. Soc.*, 33, 1039, 1911).

t°.	Gms. Zn Cl ₂ per 100 gms. sat. sol.	Solid Phase.	t°.	Gms. Zn Cl ₂ per 100 gms. sat. sol.	Solid Phase.
0....	1.60	ZnCl ₂ . 2 C ₅ H ₅ N	45....	4.66	ZnCl ₂ . 2 C ₅ H ₅ N
5....	1.80	"	55....	5.85	"
10....	2.02	"	65....	7.33	"
15....	2.28	"	75....	9.06	"
20....	2.55	"	85....	11.11	"
24.12.	2.80	"	95....	13.60	"
35....	3.67	"	105....	16.26	"

100 gms. sat. solution of zinc chloride in selenium oxychloride (Se O Cl₂) contain 1.10 gms. Zn Cl₂ at 25°.

(Wise, 1923.)

100 gms. Liquid Sulfur Dioxide dissolve 0.16 gm. ZnCl₂ at 0°. (Jander and Ruppolt, 1937.)

ZINC CHLORIDE . 2 Thiourea, ZnCl₂ . 2(NH₂)₂CS.

One liter of its saturated solution in Water contains 174.8 gms. of the compound at about 20°. (Walter and Reimer, 1934.)

ZINC CHLORATE $\text{Zn}(\text{ClO}_3)_2 \cdot 6\text{H}_2\text{O}$.

SOLUBILITY IN WATER.

(Meusser, 1902; at 18°, Mylius and Funk, 1897.)

t°.	Gms. $\text{Zn}(\text{ClO}_3)_2$ per 100 Gms. Solution.	Mols. $\text{Zn}(\text{ClO}_3)_2$ per 100 Mols. H_2O .	Solid Phase.	t°.	Gms. $\text{Zn}(\text{ClO}_3)_2$ per 100 Gms. Solution.	Mols. $\text{Zn}(\text{ClO}_3)_2$ per 100 Mols. H_2O .	Solid Phase.
-18	55.62	9.70	$\text{Zn}(\text{ClO}_3)_2 \cdot 6\text{H}_2\text{O}$	30	67.66	16.20	$\text{Zn}(\text{ClO}_3)_2 \cdot 4\text{H}_2\text{O}$
0	59.19	11.08	"	40	69.06	17.29	"
8	60.20	11.72	"	55	75.44	24	"
15	67.32	15.96	"	Ice curve			
18	66.52	15.39	$\text{Zn}(\text{ClO}_3)_2 \cdot 4\text{H}_2\text{O}$	-13	30.27	3.36	Ice
				-9	26.54	2.80	"

Sp. Gr. of solution saturated at 18° = 1.916.

ZINC Per CHLORATE $\text{Zn}(\text{ClO}_4)_2 \cdot 6\text{H}_2\text{O}$.

ClO

100 gms. Furfural dissolve 85 gms. $\text{Zn}(\text{ClO}_4)_2 \cdot (?6\text{H}_2\text{O})$ at about 20°.
 " " Cellosolve(1) " 130 " " " "
 (1) Mono ethyl ether of ethylene glycol. (Charey and Mann, 1931.)

ZINC Hexa Antipyrine Per CHLORATE $[\text{Zn}(\text{COC}_{10}\text{H}_{12}\text{N}_2)_6](\text{ClO}_4)_2$.

100 cc sat. solution of this salt in water contain 10.2 gms.
 $[\text{Zn}(\text{COC}_{10}\text{H}_{12}\text{N}_2)_6](\text{ClO}_4)_2$ at 20°. (Wilke-Dörfurt and Schliephake, 1929.)

ZINC CHROMATES.

EQUILIBRIUM IN THE SYSTEM ZINC OXIDE, CHROMIUM TRIOXIDE AND WATER AT 25°.

(Gröger, 1911.)

CrO

An excess of ZnO was, in each case, shaken for 3 days at 25°, with gradually increasing concentrations of chromic acid.

Gms. per Liter Sat. Sol.		Solid Phase.	Gms. per Liter Sat. Sol.		Solid Phase.
ZnO.	CrO ₃ .		ZnO.	CrO ₃ .	
0.409	0.604	$4\text{ZnO} \cdot \text{CrO}_3 \cdot 3\text{H}_2\text{O}$	66.1	151	$4\text{ZnO} \cdot \text{CrO}_3 \cdot 3\text{H}_2\text{O}$
2.24	4.19	"	83.7	192	" + $3\text{ZnO} \cdot 2\text{CrO}_3 \cdot \text{H}_2\text{O}$
5.86	11.5	" + $3\text{ZnO} \cdot \text{CrO}_3 \cdot 2\text{H}_2\text{O}$	123	285	$3\text{ZnO} \cdot 2\text{CrO}_3 \cdot \text{H}_2\text{O}$
10.7	22.2	$3\text{ZnO} \cdot \text{CrO}_3 \cdot 2\text{H}_2\text{O}$	193	450	"
26.7	57.5	"	196	461	" + $\text{ZnO} \cdot \text{CrO}_3 \cdot \text{H}_2\text{O}$
30.4	66.7	" + $4\text{ZnO} \cdot \text{CrO}_3 \cdot 3\text{H}_2\text{O}$	202	475	$\text{ZnO} \cdot \text{CrO}_3 \cdot \text{H}_2\text{O}$
32.2	70.6	$4\text{ZnO} \cdot \text{CrO}_3 \cdot 3\text{H}_2\text{O}$	389	940	"

SOLUBILITY OF ZINC FLUORIDE IN WATER.

t°	Gms. ZnF_2 per 100 cc sat. sol.	Solid Phase	Authority
18	1.6	$\text{ZnF}_2 \cdot 4\text{H}_2\text{O}$	(Dietz, 1900.)
20	1.62	"	(Kurtenacker, Finger and Hey, 1933.)
25	1.516	"	(Carter, 1928.)

SOLUBILITY OF ZINC FLUORIDE IN AQUEOUS SOLUTIONS OF
HYDROFLUORIC ACID AT 20° .
(Kurtenacker, Finger and Hey, 1933.)

Gms. per 100 gms. sat. sol.		Solid Phase
HF	ZnF_2	
2.47	2.54	$\text{ZnF}_2 \cdot 4\text{H}_2\text{O}$
3.69	4.98	"
17.38	9.53	"
25.43	11.40	"
29.16	11.84	"

SOLUBILITY OF ZINC FLUORIDE AT 20° IN AQUEOUS SOLUTIONS OF:
(Kurtenacker, Finger and Hey, 1933.)

Ammonium Fluoride

Potassium Fluoride

Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase
NH_4F	ZnF_2		K F	ZnF_2	
4.0	0.46	$\text{ZnF}_2 \cdot 4\text{H}_2\text{O}$	1.5	0.25	Mixed crystals
8.6	0.31	"	10.0	0.025	"
13.0	0.16	$\text{ZnF}_2 \cdot 2\text{NH}_4\text{F} \cdot 2\text{H}_2\text{O}$	19.0	—	"
20.4	0.05	"	26.5	—	"
28.0	0.03	"	34.0	—	"
39.8	0.027	"	41.8	—	"

The mixed crystals contained per 1 mol. ZnF_2 from 1.2 to 1.4 mol. KF.

ZINC Hexa Antipyrine Boro FLUORIDE $[\text{Zn}(\text{COC}_{10}\text{H}_{12}\text{N}_2)_6](\text{BF}_4)_2$.

100 cc sat. sol. of this salt in water contain 16.4 gms. $[\text{Zn}(\text{COC}_{10}\text{H}_{12}\text{N}_2)_6](\text{BF}_4)_2$ at 20° . (Wilke-Dörfurt and Nureck, 1929.)

ZINC Silico FLUORIDE $\text{ZnSiF}_6 \cdot 6\text{H}_2\text{O}$.

SOLUBILITY OF ZINC SILICO FLUORIDE IN WATER.
(Jatlov and Pinasevskaja, 1938.)

t°	Gms. ZnSiF_6 per 100 gms. sat. sol.	Solid Phase	t°	Gms. ZnSiF_6 per 100 gms. sat. sol.	Solid Phase
- 0.8	5.0	Ice	0	33.73	$\text{ZnSiF}_6 \cdot 6\text{H}_2\text{O}$
- 1.4	10.0	"	20	35.16	"
- 3.2	15.0	"	20 (d=1.4336)	32.86 (1)	"
- 4.8	20.0	"	40	37.04	"
- 7.4	25.0	"	60	38.49	"
-11.8	30.	"	80	40.95	"
-14.6	32.	" + $\text{ZnSiF}_6 \cdot 6\text{H}_2\text{O}$	100	42.18	"

SOLUBILITY OF ZINC SILICO FLUORIDE IN SILICO FLUORIC ACID AT 20°.
(Jatlov and Pinaevskaya, 1938.)

Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase
H_2SiF_6	ZnSiF_6		H_2SiF_6	ZnSiF_6	
0.0	35.16	$\text{ZnSiF}_6 \cdot 6\text{H}_2\text{O}$	14.15	20.13	$\text{ZnSiF}_6 \cdot 6\text{H}_2\text{O}$
1.0	34.90	"	26.13	8.47	"
1.81	33.65	"	37.40	3.69	"
6.20	27.64	"	48.95	0.78	"

ZINC IODIDE ZnI_2 .

SOLUBILITY IN WATER.

(Dietz, 1900; see also Etard, 1894.)

t°.	Gms. ZnI_2 per 100 Gms. Solution.	Mols. ZnI_2 per 100 Mols. H_2O .	Solid Phase.	t°.	Gms. ZnI_2 per 100 Gms. Solution.	Mols. ZnI_2 per 100 Mols. H_2O .	Solid Phase.
-10	80.50	23.3	$\text{ZnI}_2 \cdot 2\text{H}_2\text{O}$	0	81.11	24.2	ZnI_2
-5	80.77	23.7	"	18	81.20	24.4	"
0	81.16	24.3	"	40	81.66	25.1	"
+10	82.06	25.8	"	60	82.37	26.4	"
22	83.12	27.8	"	80	83.05	27.5	"
27	89.52	50.3	"	100	83.62	28.7	"

Sp. Gr. of sat. solution of the anhydrous salt at 18° = 2.725.

100 gms. glycerol dissolve 40 gms. ZnI_2 at 15.5°.

(Ossendowski, 1907.)

EQUILIBRIUM IN THE SYSTEM ZINC IODIDE, ETHYL ETHER AND WATER.

(Gumpel, 1929.)

I

Zinc iodide greatly increases the mutual solubility of ether and water. The system has an upper critical solution temperature. At concentrations of salt less than 70 percent a homogeneous liquid is not obtained by increase of temperature.

t° of saturation	Wt. Percent ZnI_2 in aq. solution	Gms. $(\text{C}_2\text{H}_5)_2\text{O}$ per 100 gms. $(\text{C}_2\text{H}_5)_2\text{O} + \text{H}_2\text{O}$	t° of saturation	Wt. Percent ZnI_2 in aq. solution	Gms. $(\text{C}_2\text{H}_5)_2\text{O}$ per 100 gms. $(\text{C}_2\text{H}_5)_2\text{O} + \text{H}_2\text{O}$
-6.0	69.93	10.40	21.2	79.86	60.45
+22.4	"	15.68	18.2	"	65.05
39.8	"	22.32	13.5	"	69.21
47.9	"	28.03	3.8	"	75.77
54.5	"	32.81	0.0	84.64	44.10
60.6	"	37.50	+3.6	"	51.75
0.0	74.59	11.96	3.4	"	61.75
+24.0	"	28.11	-1.1	"	66.80
45.2	"	49.37	-6.0	"	68.42
51.1	"	54.67	-2.0	"	73.63
56.0	"	56.0	-3.0	"	74.10
62.6	"	64.4	-5.9	85.08	42.00
-2.1	79.86	15.70	-3.4	"	45.53
+11.1	"	27.30	-0.5	"	54.21
12.6	"	30.79	-2.6	"	65.54
16.5	"	37.74	-12.2	"	70.36
22.0	"	52.98	-30.0	"	75.66
21.5	"	58.73			

100 cc Pyridine dissolve 12.6 gms. ZnI_2 at 18°. (Müller, R., 1924.)

100 gms. Liquid Ammonia dissolve 0.10 gm. ZnI_2 at 0° . (Hunt and Boncyk, 1933.)

100 gms. Liquid Sulfur Dioxide dissolve 0.11 gm. ZnI_2 at 0° . (Jander and Ruppolt, 1937.)

ZINC IODATE $\text{Zn}(\text{IO}_3)_2$.

100 gms. H_2O dissolve 0.87 gm. $\text{Zn}(\text{IO}_3)_2$ cold and 1.31 gms. hot.
(Rammelsberg, 1838.)

ZINC NITRATE $\text{Zn}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$.

SOLUBILITY OF ZINC NITRATE IN WATER.

(Sieverts and Petzold, 1933.)

The earlier determinations of Funk, 1900, and of Jones and Getman, 1904, for the ice curve, are in general agreement with the results of Sieverts and Petzold.

t°	Gms. $\text{Zn}(\text{NO}_3)_2$ per 100 gms. sat. sol.	Solid Phase	t°	Gms. $\text{Zn}(\text{NO}_3)_2$ per 100 gms. sat. sol.	Solid Phase
-5.8	16.4	Ice	36.4 m.pt.	—	$\text{Zn}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$
-12.0	25.4	"	35.8	65.0	" + $\text{Zn}(\text{NO}_3)_2 \cdot 4\text{H}_2\text{O}$
-19.6	31.7	"	43.5	69.7	$\text{Zn}(\text{NO}_3)_2 \cdot 4\text{H}_2\text{O}$
-28.0	37.1	"	45.0	70.2	"
-32.0	38.9	" + $\text{Zn}(\text{NO}_3)_2 \cdot 9\text{H}_2\text{O}$	45.5 m.pt.	—	"
-29.0	39.7	$\text{Zn}(\text{NO}_3)_2 \cdot 9\text{H}_2\text{O}$	45.0	73.8	"
-23.0	40.8	"	43.5	75.8	"
-19.5	42.9	"	37.0	77.9	" + $\text{Zn}(\text{NO}_3)_2 \cdot 2\text{H}_2\text{O}$
-17.6	—	" $\rightarrow \text{Zn}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$	51	80.7	$\text{Zn}(\text{NO}_3)_2 \cdot 2\text{H}_2\text{O}$
-23.0	43.5*	$\text{Zn}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$	54 m.pt.	83.2	"
-19.0	44.5*	"	51.8	86.2	" + $\text{Zn}(\text{NO}_3)_2 \cdot \text{H}_2\text{O}$
+ 0.4	48.3	"	59.0	87.2	$\text{Zn}(\text{NO}_3)_2 \cdot \text{H}_2\text{O}$
30.0	58.1	"	73.1	89.9	"
35.0	61.2	"	73.9	91.2	"
			73.0	92.6	"

* = Metastable.

The following very accurate determinations made by the freezing-point method are given by Ewing, McGovern and Mathews, Jr., 1933.)

t°	Gms. $\text{Zn}(\text{NO}_3)_2$ per 100 gms. sat. sol.	Solid Phase	t°	Gms. $\text{Zn}(\text{NO}_3)_2$ per 100 gms. sat. sol.	Solid Phase
25.1	56.1	$\text{Zn}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$	38.2	77.8	$\text{Zn}(\text{NO}_3)_2 \cdot 4\text{H}_2\text{O}$
27.3	56.9	"	37.2	78.0	" + $\text{Zn}(\text{NO}_3)_2 \cdot 2\text{H}_2\text{O}$
30.4	58.3	"	32.2	79.0*	"
32.4	59.5	"	43.6	79.7	$\text{Zn}(\text{NO}_3)_2 \cdot 2\text{H}_2\text{O}$
34.1	60.8	"	44.9	79.8	"
36.1 m.pt.	63.4	"	51.9	81.9	"
35.4	65.2	"	55.4 m.pt.	84.0	"
34.6	66.2	" + $\text{Zn}(\text{NO}_3)_2 \cdot 4\text{H}_2\text{O}$	55.2	85.2	"
33.3	67.4*	"	52.1	86.3	" + $\text{Zn}(\text{NO}_3)_2 \cdot \text{H}_2\text{O}$
40.0	67.9	$\text{Zn}(\text{NO}_3)_2 \cdot 4\text{H}_2\text{O}$	52.8	86.6	$\text{Zn}(\text{NO}_3)_2 \cdot \text{H}_2\text{O}$
43.2	70.0	"	59.2	87.6	"
44.7 m.pt.	72.5	"	65.2	88.6	"
42.4	75.8	"	68.6	89.4	"
39.7	77.2	"	70.7	90.0	"

* = Metastable.

EQUILIBRIUM IN THE SYSTEM ZINC NITRATE, NITRIC ACID AND WATER AT 20°.
(Malquori, 1928.)

Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase
Zn(NO ₃) ₂	HNO ₃		Zn(NO ₃) ₂	HNO ₃	
54.03	0.0	Zn(NO ₃) ₂ ·6H ₂ O	36.02	36.11	Zn(NO ₃) ₂ ·4H ₂ O
48.13	10.40	"	32.75	38.10	"
42.09	18.11	"	29.28	49.22	"
36.15	25.35	"	29.03	50.82	"
32.71	30.15	"	29.00	57.19	"
36.11	34.45	" + Zn(NO ₃) ₂ ·4H ₂ O	29.57	59.21	"

The following more complete data for this system at 25° are given by Ewing, Richards, Taylor Jr., and Winkler, 1933.

Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase
Zn(NO ₃) ₂	HNO ₃		Zn(NO ₃) ₂	HNO ₃	
56.1	0.0	Zn(NO ₃) ₂ ·6H ₂ O	64.2	14.9*	Zn(NO ₃) ₂ ·4H ₂ O
53.1	3.5	"	62.2	17.9	" + Zn(NO ₃) ₂ ·2H ₂ O
49.4	9.5	"	65.9	12.8*	Zn(NO ₃) ₂ ·2H ₂ O
46.8	15.5	"	57.9	22.6	"
47.6	16.6	"	55.2	26.6	"
49.7	15.5	" + Zn(NO ₃) ₂ ·4H ₂ O	44.6	42.1	"
41.5	24.0	Zn(NO ₃) ₂ ·4H ₂ O	44.9	43.5	"
34.6	36.7	"	46.7	42.2	"
35.0	39.2	"	52.6	36.9	"
37.5	38.0	"	52.1	37.4	Zn(NO ₃) ₂ ·H ₂ O
41.4	35.1	"	43.5	47.4	"
45.9	31.6	"	28.1	65.5	"
54.0	24.5	"	15.3	78.9	"
60.5	18.5	"	11.6	85.9	"
62.2	16.8*	"	9.9	88.8	"

EQUILIBRIUM IN THE SYSTEM ZINC OXIDE, NITROGEN PENTOXIDE AND WATER.
(Denham and Dick, 1931.)

Results at 25°

Results at 50°

d. of sat. sol.	Gms. per 100 gms. sat. sol.		Solid Phase	d. of sat. sol.	Gms. per 100 gms. sat. sol.		Solid Phase
	N ₂ O ₅	ZnO			N ₂ O ₅	ZnO	
1.015	1.0	0.8	1.5.3	1.022	1.6	1.0	1.5.3
1.094	5.7	4.6	"	1.116	7.5	5.9	"
1.218	12.7	9.7	"	1.401	21.6	16.9	"
1.380	20.3	15.5	"	1.476	24.7	19.0	"
1.585	27.9	21.5	" + 1.1.3	1.503	25.6	19.9	"
1.657	30.6	22.0	1.1.3	1.544	26.7	20.8	" + 1.1.3
1.695	31.8	23.5	" + Zn(NO ₃) ₂ ·6H ₂ O	1.571	27.4	21.3	1.1.3
1.675	33.5	22.0	Zn(NO ₃) ₂ ·6H ₂ O	1.613	29.5	22.6	"
1.679	39.6	20.2	"	1.660	31.1	23.8	"
1.737	42.6	21.4	" + Zn(NO ₃) ₂ ·4H ₂ O	1.750	34.4	26.4	"
1.737	42.6	21.3	Zn(NO ₃) ₂ ·4H ₂ O	1.793	36.0	27.2	"
1.695	45.6	18.6	"	1.941	40.8	30.9	"

1.5.3 = Zn(NO₃)₂·5ZnO·3H₂O; 1.1.3 = Zn(NO₃)₂·ZnO·3H₂O.

SOLUBILITY OF ZINC NITRATE IN LIQUID AMMONIA.

(Donskaja and Portnov, 1939.)

t°	Gms. Zn(NO ₃) ₂ per 100 gms. NH ₃	Solid Phase	t°	Gms. Zn(NO ₃) ₂ per 100 gms. NH ₃	Solid Phase
-79	1.06	NH ₃	-39	33.62	Zn(NO ₃) ₂ ·8NH ₃
-79	6.61	"	-31	31.88	"
-78.5	11.71	"	0	29.01	" + Zn(NO ₃) ₂ ·6NH ₃
-78	16.34	"	+43	31.88	Zn(NO ₃) ₂ ·6NH ₃
-77	20.11	" + Zn(NO ₃) ₂ ·10NH ₃	48	53.62	"
-75	22.17	Zn(NO ₃) ₂ ·10NH ₃	58	35.18	" + Zn(NO ₃) ₂ ·4NH ₃
-73	24.10	"	60	37.81	Zn(NO ₃) ₂ ·4NH ₃
-71	26.36	"	63	40.38	"
-67	29.01	"	68	44.67	"
-62	31.88	"	75	50.30	"
-60	33.62	"	79	55.09	"
-58	35.10	" + Zn(NO ₃) ₂ ·8NH ₃	101	71.38	"
			125	85.40	"

ZINC HYDROXIDE Zn(OH)₂.

SOLUBILITY OF ZINC OXIDE (HYDROXIDE) IN WATER AT 18°.

(Remy and Kuhlmann, 1924; Remy, 1925.)

The determinations were made by (1) the ordinary electrolytic conductivity method, taking into consideration the carbonate content of the water and assuming that the zinc is present as completely dissociated hydroxide, and (2) by a conductotitrimetric method.

By method (1) there was found 0.00306 gms. or 0.038 millimols ZnO per liter.
 " " (2) " " 0.00292 " 0.036 " " "

OH

The solubility of Zinc Hydroxide in Water, determined by electrometric titration, is given by Busch, 1927, as 1.92×10^{-5} gm. mol. ZnO per liter at 29°.

One liter of water dissolves 0.0042 gm. ZnO at 18° as determined by the conductivity method. (Dupre, .)

One liter of water dissolves 0.0042 gm. ZnO at 18°, conductivity method.

(Dupre and Bialas, 1903.)

One liter of water dissolves 0.01 gm. at 25°.

(Bodländer, 1898.)

SOLUBILITY OF ZINC HYDROXIDE IN AQUEOUS SOLUTIONS OF:

Ammonia and Ammonia Bases at 17°-19°.

(Herz, 1902.)

Sodium Hydroxide at Ord. Temp.

(Rubenbauer, 1902.)

Normality of the Base.	Normality of Dis- solved Zn.	Gms. ZnO per 20 cc. Solution.	Gms. per 20 cc. Solution		Mol. Dilution of the NaOH.
			Na.	Zn.	
0.0942NH ₃	0.0011	0.00185	0.1012	0.0040	4.50
0.236 "	0.0110	0.0180	0.1978	0.0150	2.33
0.707 "	0.059	0.0958	0.4278	0.0442	1.06
0.0944NH ₂ CH ₃	0.0005	0.0008	0.6670	0.1771	0.70
0.472 "	0.0081	0.0132	0.9660	0.9630	0.48
0.944 "	0.03	0.0484	1.4951	0.2481	0.31
0.068 NH ₂ C ₂ H ₅	0.0003	0.0005	2.9901	0.3700	0.16
0.51 "	0.0045	0.0074	Moist Zn (OH) ₂ used. So- lutions shaken 5 hours.		
0.68 "	0.0098	0.0161			

SOLUBILITY OF ZINC HYDROXIDE IN AQUEOUS SOLUTIONS OF AMMONIUM HYDROXIDE.

Results of Euler (1903).

t°.	Normality of Aq. Ammonia.	Mols. Zn per Liter.
15-17	0.485	0.013-0.010*
15-17	0.97	0.034
21	0.253	0.0029
21	0.259	0.0022*
21	0.500	0.0097
21	0.518	0.0070

Results of Bonsdorff (1904) at 25°.

Normality of Aq. Ammonia.	Gms. ZnO per Liter.	Normality of Aq. Ammonia.	Gms. ZnO per Liter.
0.311	0.85	0.321	0.34
0.825	3.84	0.643	0.845
1.287	7.28	1.215	2.70
		1.928	5.07
		2.570	7.01
		3.213	10.16

Euler states that the higher results of Herz are due to incompletely purified zinc hydroxide and uses material precipitated from the nitrate for his experiments. Different preparations of $\text{Zn}(\text{OH})_2$ containing from 55 to 77 per cent H_2O were used and in the two cases marked * ZnO was used.

Bonsdorff used for his second series of determinations, $\text{Zn}(\text{OH})_2$ precipitated from the nitrate and brought in moist condition into the ammonia solutions.

OH

SOLUBILITY OF CRYSTALLINE ZINC HYDROXIDE IN AQUEOUS SOLUTIONS OF AMMONIUM HYDROXIDE AND OF SODIUM HYDROXIDE AT 25°.

(Dietrich and Johnston, 1927.)

Attention is called to the discordant character of previous results due to the uncertain nature of the solid phase present in each case. The authors used crystalline zinc hydroxide prepared by dissolving washed precipitated zinc hydroxide in ammonia and gradually removing the ammonia from the solution by absorption from the vapor phase by concentrated sulfuric acid. The crystals which gradually deposit contain 18.12% H_2O corresponding to pure $\text{Zn}(\text{OH})_2$. Equilibrium was reached within 24 hours. The following are the interpolated values from the average experimental results.

Gm. Mol. NaOH or NH_4OH per 1000 gms. H_2O	Gm. Mols. $\text{Zn}(\text{OH})_2$ dissolved per 1000 gms. H_2O in aq.:		Gm. Mol. NaOH or NH_4OH per 1000 gms. H_2O	Gm. Mols. $\text{Zn}(\text{OH})_2$ dissolved per 1000 gms. H_2O in aq.:	
	NH_4OH	NaOH		NH_4OH	NaOH
0.0	0.00002	0.00002	1.5	0.0496	0.1042
0.2	0.00130	0.00206	2.0	0.0790	0.1832
0.3	0.00275	0.00444	2.5	0.1105	0.2845
0.4	0.00468	0.00760	3.0	0.1428	0.4065
0.5	0.00705	0.0115	3.5	0.1757	0.5470
0.75	0.0147	0.02625	4.0	0.2096	0.7032
1.0	0.0246	0.0468	5.0	0.2785	1.0740

Results are also given for 0° and 35°.

SOLUBILITY OF ZINC HYDROXIDE IN AQUEOUS POTASSIUM HYDROXIDE SOLUTIONS.

(Klein, 1912.)

The determinations were made by adding aq. ZnSO_4 solution (containing one gm. mol. per liter) to aq. KOH solutions until a permanent precipitate just appeared. The titrations are also recalculated to mols. per liter and correction made for the dilution of the KOH solution by the aq. ZnSO_4 .

Normality of Aq. KOH.	cc. ZnSO_4 Sol. per 50 cc. Aq. KOH.	Calculated Mols. per Liter of Sat. Sol.		
		Orig. Conc. KOH.	Corrected Conc. of KOH.	Conc. of Zn.
1	5.5	1	0.9	0.10
1.78	13.1	1.78	1.42	0.209
2	14.3	2	1.56	0.223
2.22	17.9	2.22	1.63	0.266
2.5	18.8	2.5	1.81	0.272
3	24.6	3	2.02	0.330
3.6	29.1	3.6	2.28	0.368
4	34	4	2.38	0.405
6	56 (?)	6	2.78	0.540

SOLUBILITY OF ZINC HYDROXIDE IN AQUEOUS SODIUM HYDROXIDE AT 30°.

(Fricke, 1928.)

OH

The mixtures were agitated for periods up to 15 days. The solubility increased with time owing to the formation of ZnO .

Gms. per 100 gms. sat. sol.		Gms. per 100 gms. sat. sol.	
NaOH	ZnO	NaOH	ZnO
7.10	1.44	22.0	8.76
13.3	5.15	24.6	12.81
13.7	6.81	28.3	13.8
17.8	9.81	31.75	21.57

Results for the solubility of calcined and hydrated zinc oxide in aqueous solutions of NaOH and of KOH, and for sodium zincate in aqueous solutions of NaOH are given by Müller, Müller and Fouvel, 1927.

SOLUBILITY OF ZINC HYDROXIDE IN ONE PER CENT AQUEOUS SALT SOLUTIONS AT 16°-20°.

(Snyder, 1878.)

The CO_2 free $\text{Zn}(\text{OH})_2$ dissolved is calculated as milligrams Zn per liter of the given salt solution. Additional determinations are also given.

Aq. Salt Solution.	Mgs. Zn per Liter Solution.	Aq. Salt Solution.	Mgs. Zn per Liter Solution.	Aq. Salt Solution.	Mgs. Zn per Liter Solution.
NaCl	51	K_2SO_4	37.5	K_2CO_3	0
KCl	43	MgSO_4	27	NH_4Cl	95
CaCl_2	57.5	KNO_3	17.5	NH_4NO_3	77
MgCl_2	65	$\text{Ba}(\text{NO}_3)_2$	25	$(\text{NH}_4)_2\text{SO}_4$	88
BaCl_2	38				

ZINC PHOSPHATES $\text{Zn}_3(\text{PO}_4)_2 \cdot 4\text{H}_2\text{O}$, $\text{ZnHPO}_4 \cdot 3\text{H}_2\text{O}$, $\text{Zn}(\text{H}_2\text{PO}_4)_2 \cdot 2\text{H}_2\text{O}$.

EQUILIBRIUM IN THE SYSTEM ZINC OXIDE, PHOSPHORUS PENTOXIDE
AND WATER AT 25° AND AT 37°. (Eberly, Gross and Crowell, 1920.)

The flasks containing the mixtures were kept in thermostats and occasionally shaken during several weeks. The analyses of the saturated solutions and solid phases were repeated at intervals of two weeks until constant results were obtained.

Results at 25°.

Results at 37°.

Gms. per 100 gms. sat. sol.		Solid Phase.	Gms. per 100 Gms. sat. sol.		Solid Phase.
P_2O_5 .	ZnO.		P_2O_5 .	ZnO.	
5.08	2.38	$\text{Zn}_3(\text{PO}_4)_2 \cdot 4\text{H}_2\text{O}$	4.87	2.08	$\text{Zn}_3(\text{PO}_4)_2 \cdot 4\text{H}_2\text{O}$
9.76	4.65	"	9.46	4.12	"
12.42	6.13	"	13.60	6.27	"
13.52	6.56	"	18.13	8.78	"
14.00	6.74	"	19.48	9.66	"
14.37	6.97	"	20.32	10.16	"
14.83	7.37	"	21.96	10.88	$\text{ZnHPO}_4 \cdot 3\text{H}_2\text{O}$
15.98	7.71	$\text{ZnHPO}_4 \cdot 3\text{H}_2\text{O}$	26.75	13.26	"
17.15	8.26	"	29.65	14.77	"
18.33	8.73	"	33.39	17.06	"
22.75	10.74	"	34.58	17.92	"
26.48	12.47	"	36.13	16.00	$\text{ZnHPO}_4 \cdot \text{H}_2\text{O}$
28.70	13.48	"	37.80	15.78	"
30.09	14.16	"	39.93	16.12	"
32.55	15.40	"	42.42	15.81	"
33.79	15.82	"	42.65	16.82	"
37.15	17.30	"	44.89	17.83	"
39.61	18.04	"	46.11	18.05	$\text{Zn}(\text{H}_2\text{PO}_4)_2 \cdot 2\text{H}_2\text{O}$
42.05	16.14	$\text{Zn}(\text{H}_2\text{PO}_4)_2 \cdot 2\text{H}_2\text{O}$	46.41	14.74	"
44.53	13.20	"	48.99	12.55	"
48.70	9.58	"	51.35	11.26	"
52.25	7.64	"	51.92	11.12	"
55.97	7.23	"	54.32	10.82	"

ZINC Ammonium PHOSPHATE ZnNH_4PO_4 .

One liter sat. solution in water contains 0.0136 gm. ZnNH_4PO_4 at 10.5° and 0.0145 gm. at 17.5°. (Artmann, 1915.)

ZINC Tetrammine Per RHENATE $[\text{Zn}(\text{NH}_3)_4](\text{ReO}_4)_2$.

One liter sat. solution of this salt in aqueous ammonia of $d = 0.930$ (19 percent) contain 1.852 gm. at 20°. (Wilke-Dörfurt and Gunzert, 1933.)

ZINC SULFIDE ZnS .

S

Critical reviews of the published determinations of the solubilities of the metal sulfides in water are given by Kolthoff, 1931, and Ravitz, 1936. The preferred value for ZnS , calculated by Ravitz with the aid of recent viscosity data, is 1.47×10^{-9} gm. mols. per liter.

1000 cc. aq. 2.0 n H_2SO_4 , sat. with H_2S at 1 atmosphere pressure, dissolve 0.6172 gm. ZnS ($= 6.34 \cdot 10^{-3}$ gm. mols. ZnS) at 20°. (Moser and Behr, 1924.)

EQUILIBRIUM IN THE SYSTEM ZINC OXIDE, SULFUR DIOXIDE AND WATER.
(Terres and Ruhl, 1934.)

The determinations were made by the synthetic method. The results are given in the present paper only in the form of a small diagram from which the following approximate values were read.

Results at 15°

Results at 25°

Mol. Percent in sat. sol.		Solid Phase	Mol. Percent in sat. sol.		Solid Phase
ZnO	SO_2		ZnO	SO_2	
1.0	2.1	$\text{ZnSO}_3 \cdot 2\frac{1}{2}\text{H}_2\text{O}$	1.0	2.4	$\text{ZnSO}_3 \cdot 2\frac{1}{2}\text{H}_2\text{O}$
2.0	4.0	"	2.0	4.6	"
2.55	5.0	" + $\text{Zn}(\text{HSO}_3)_2(?)$	2.8	6.0	" + $\text{Zn}(\text{HSO}_3)_2(?)$
2.5	6.0	$\text{Zn}(\text{HSO}_3)_2(?)$	2.0	6.4	$\text{Zn}(\text{HSO}_3)_2(?)$
3.0	7.2	"	1.5	7.0	"
4.0	9.1	"	1.3	9.0	"
5.0	10.75	"	1.5	9.0	"
5.6	11.8*	"	2.0	10.0	"
			3.3	11.8*	"

* Between 11.8 and 84 Mol. percent SO_2 the mixtures separated into two liquid layers.

100 gms. H_2O dissolve 0.16 gm. $\text{ZnSO}_3 \cdot 2\text{H}_2\text{O}$.

(Houston and Trichborne, 1890.)

SO

ZINC SULFATE $\text{ZnSO}_4 \cdot 6\text{H}_2\text{O}$.

SOLUBILITY OF ZINC SULFATE IN WATER.

(Bury, 1924; Cohen and Hettenschij, 1925; Cohen and Moesveld, 1925.)

The very exact determinations of these authors were plotted and the following table constructed from the curves.

t°.	Gms. ZnSO_4 per 100 gms. H_2O .	Solid Phase.	t°.	Gms. ZnSO_4 per 100 gms. H_2O .	Solid Phase.
0.....	41.61	$\text{ZnSO}_4 \cdot 7\text{H}_2\text{O}$ (Rhombic)	10.....	58.6	$\text{ZnSO}_4 \cdot 6\text{H}_2\text{O}$
5.....	44.41	"	15.....	60.2	"
10.....	47.25	"	20.....	61.8	"
15.....	50.34	"	24.8 tr. pt.	63.4	" + $\text{ZnSO}_4 \cdot 7\text{H}_2\text{O}$ (Monoclinic)
20.....	53.80	"	25.....	63.5	"
25.....	57.45	"	30.....	65.5	"
30.....	61.30	"	35.....	68.0	"
35.....	66.17	"	37.9 tr. pt.	69.4	" + $\text{ZnSO}_4 \cdot 7\text{H}_2\text{O}$ (Rhombic)
37.9 tr. pt.	69.4	" + $\text{ZnSO}_4 \cdot 6\text{H}_2\text{O}$	40.....	70.5	$\text{ZnSO}_4 \cdot 6\text{H}_2\text{O}$
40.....	54.4	$\text{ZnSO}_4 \cdot 7\text{H}_2\text{O}$ (Monoclinic)	45.....	73.0	"
45.....	57.0	"	50.....	76.2	"
50.....	60.0	"	55.....	80.0	"
55.....	63.4	" + $\text{ZnSO}_4 \cdot 6\text{H}_2\text{O}$	60.....	85.2	"

The following more recent determinations are given by Schröder, 1936.

t°	d. of sat. sol.	Gms. ZnSO ₄ per 100 gms. sat. sol.	Solid Phase	t°	d. of sat. sol.	Gms. ZnSO ₄ per 100 gms. sat. sol.	Solid Phase
0	1.3796	29.58	ZnSO ₄ ·7H ₂ O	50	1.6072	43.20	ZnSO ₄ ·6H ₂ O
25	1.4921	36.67	"	54.5	—	—	" + 7H ₂ O
33	1.5320	39.17	"	60	1.5921	42.98	ZnSO ₄ ·H ₂ O
37	1.5502	40.50	"	75	1.5382	40.93	"
44	1.5836	41.98	ZnSO ₄ ·6H ₂ O	86	1.5041	39.26	"
				99	1.4623	37.70	"

Other determinations in satisfactory agreement with the above are given by Caven and Johnston, 1926, 1928 and Benrath, 1931.

Data for the solubility of ZnSO₄ in water at high pressures are given by Cohen and Sinnige, 1909, 1910.

SOLUBILITY OF ZINC SULFATE IN AQUEOUS SOLUTIONS OF SULFURIC ACID.
(Agde and Schimmel, 1928.)

t°	Gms. per 100 ZnSO ₄ ·7H ₂ O	gms. sat. sol. H ₂ SO ₄	Solid Phase	t°	Gms. per 100 ZnSO ₄ ·7H ₂ O	gms. sat. sol. H ₂ SO ₄	Solid Phase
-6.55	48.25	0.0	Ice + ZnSO ₄ ·7H ₂ O	+10	57.5	0.0	ZnSO ₄ ·7H ₂ O
-6.9	44.2	2.6	"	"	48.2	5.4	"
-8.0	35.75	7.5	"	"	41.5	11.0	"
-8.9	31.6	9.8	"	"	36.0	15.4	"
-10.0	28.0	12.5	"	"	32.0	20.3	"
"	19.5	19.3	ZnSO ₄ ·7H ₂ O	"	28.0	24.75	"
"	12.3	30.0	"	"	24.4	36.0	"
"	3.5	41.7	"	18.2	38.0	25.4	{ ZnSO ₄ ·7H ₂ O → ZnSO ₄ ·6H ₂ O }
0	52.6	0.0	"	"	52.5	14.2	"
"	48.6	2.5	"	28.5	73.5	0.0	"
"	36.5	10.0	"	39.1	63.1	0.0	ZnSO ₄ ·6H ₂ O
"	27.7	16.9	"	20	56.0	4.8	"
"	25.0	20.4	"	"	48.7	10.25	"
"	18.6	30.0	"	"	42.75	17.25	"
"	17.0	34.6	"	30	68.4	0.0	"
				"	61.2	5.2	"

SOLUBILITY OF ZINC SULFATE IN AQUEOUS SOLUTIONS OF
SULFURIC ACID AT 12.5°.
(Montmartini and Losana, 1928.)

d. of sat. sol.	Gms. per 100 ZnSO ₄	gms. sat. sol. H ₂ SO ₄	Solid Phase	d. of sat. sol.	Gms. per 100 ZnSO ₄	gms. sat. sol. H ₂ SO ₄	Solid Phase
1.4214	33.28	0.0	Zn7	1.4116	5.92	44.36	Zn6 + Zn2
1.3930	26.64	7.71	"	1.4620	1.19	58.76	Zn2
1.3786	20.76	16.14	"	1.5578	0.28	64.21	" + Zn
1.3888	17.02	23.64	Zn6	1.6552	0.22	72.26	Zn
1.4131	14.91	28.21	"	1.7664	0.18	81.56	"
1.4202	9.62	36.80	"	1.8402	0.16	98.96	"

Zn7 = ZnSO₄·7H₂O; Zn6 = ZnSO₄·6H₂O; Zn2 = ZnSO₄·2H₂O; Zn = ZnSO₄.

EQUILIBRIUM IN THE SYSTEM ZINC SULFATE, AMMONIA AND WATER AT 0°.
(Applebey and Windridge, 1932.)

d. of sat. sol.	Gms. per 100 NH ₃	gms. sat. sol. ZnSO ₄	Solid Phase	d. of sat. sol.	Gms. per 100 NH ₃	gms. sat. sol. ZnSO ₄	Solid Phase
1.435	17.75	42.20	1.4.2	0.956	23.56	4.37	1.4.2
1.411	18.21	40.98	"	0.917	26.79	1.26	"
1.292	20.20	37.44	"	0.912	29.30	0.65	"
1.180	20.83	25.83	"	0.903	30.46	0.40	"
1.147	21.30	22.52	"	0.900	31.23	0.35	Solid Sol.
1.097	21.26	16.14	"	0.896	32.86	0.15	"
1.006	21.89	8.98	"	—	38.52	trace	"
				—	40.50	"	"

1.4.2 = ZnSO₄·4NH₃·2H₂O; Solid solution of ZnSO₄·4NH₃ + ZnSO₄·5NH₃.

At 18° the mixtures separate into two liquid layers of the following compositions.

Lower Layer			Upper Layer			Solid Phase
d. of solution	Gms. per 100 NH ₃	gms. solution ZnSO ₄	d. of solution	Gms. per 100 NH ₃	gms. solution ZnSO ₄	
1.488	19.24	46.22	—	—	—	1.4.2
1.457	20.37	46.02	—	—	—	"
1.395	21.70	42.13	—	—	—	"
1.304	23.32	36.97	0.928	28.74	4.44	"
1.233	23.07	32.20	0.967	26.34	7.82	—
1.201	22.85	29.38	0.995	25.30	10.71	—
—	—	—	0.929	28.68	4.01	1.4.2
—	—	—	0.911	29.07	2.20	"
—	—	—	0.895	30.03	1.23	"
—	—	—	0.887	32.43	0.43	solid sol.
—	—	—	0.880	33.30	0.49	"
—	—	—	—	38.75	0.01	"

Several results similar to the above are given for other temperatures.

SOLUBILITY OF ZINC SULFATE IN AQUEOUS ETHYL ALCOHOL.
(Schiff, 1861.)

Concentration of Alcohol	10 per cent	20 per cent	40 per cent
Gms. ZnSO ₄ ·7H ₂ O per 100 Gms. Solution	51.1	39	3.45

100 gms. abs. methyl alcohol dissolve 0.65 gm. ZnSO₄ at 18°, 5.90 gms. ZnSO₄·7H₂O at 18°.

100 gms. 50 per cent methyl alcohol dissolve 15.7 gms. ZnSO₄·7H₂O at 18°.

100 gms. glycerol dissolve 35 gms. zinc sulfate at 15.5°.

(de Bruyn, 1892.)
(Ossendowski, 1907.)

SOLUBILITY OF ANHYDROUS ZINC SULFATE IN:
(Gibson, Driscoll and Jones, 1929.)

Methyl Alcohol			Ethyl Alcohol		
t°	Gms. ZnSO ₄ per 100 gms. CH ₃ OH	Solid Phase	t°	Gms. ZnSO ₄ per 100 gms. CH ₃ OH	Solid Phase
15	0.485	ZnSO ₄ · 2½CH ₃ OH	15	0.038	ZnSO ₄
25	0.425	"	25	0.034	"
35	0.408	"	35	0.029	"
45	0.420	"	55	0.020	"
55	0.463	ZnSO ₄ · CH ₃ OH(?)			

EQUILIBRIUM IN THE SYSTEM ZINC SULFATE, ACETONE AND WATER AT 25°.
(Leaming, ———)

The binodal curve for this system was determined by the titration method; tie lines or the plait point were not determined. The author's results were plotted and the following values taken from the average curve.

Gms. per 100 gms. homogeneous liquid			Gms. per 100 gms. homogeneous liquid		
ZnSO ₄	(CH ₃) ₂ CO	H ₂ O	ZnSO ₄	(CH ₃) ₂ CO	H ₂ O
30.0	4.0	66.0	11.7	17.5	70.8
27.0	5.0	68.0	9.3	20.0	70.7
25.0	6.0	69.0	7.5	22.5	70.0
22.2	7.5	70.3	5.7	25.0	69.3
19.0	10.0	71.0	4.2	27.5	68.3
16.4	12.5	71.1	3.0	30.0	67.0
14.0	15.0	71.0	2.2	32.5	65.3

The composition of the homogeneous mixture mixture (plait point) of the system Zinc Sulfate + Tertiary Butyl Alcohol + Water at 25° was found by Ginnings, Hering and Webb, 1933, to be

6.0 gms. ZnSO₄ + 25.5 gms. (CH₃)₃COH + 68.5 gms. H₂O.

The original results for the remaining points on the binodal curve are not given but only the values of a series of constants, calculated by means of empirical equations.

EQUILIBRIUM IN THE SYSTEM ZINC SULFATE URETHAN AND WATER AT 25°.
(Palitzsch, 1928, 1929.)

Gms. Mols. per 1000 gms. H ₂ O		Solid Phase
ZnSO ₄	NH ₂ COOC ₂ H ₅	
3.59	0.0	ZnSO ₄ · 7H ₂ O
0.02	49.84	Upper liquid layer
3.51	0.239	Lower liquid layer
0.0	53.09	NH ₂ COOC ₂ H ₅

ZIRCONIUM Oxy BROMIDE $\text{ZrOBr}_2 \cdot 8\text{H}_2\text{O}$.

SOLUBILITY OF ZIRCONIUM OXY BROMIDE IN AQUEOUS SOLUTIONS
OF HYDROBROMIC ACID AT 25°. C1
(v. Hevesy and Wagner, 1930.)

d. of sat. sol.	Normality of Aq. HBr	Gms. ZrO_2 per liter sat. sol.	d. of sat. sol.	Normality of Aq. HBr	Gms. ZrO_2 per liter sat. sol.
1.7488	1.046	355.7	1.4900	4.50	125.3
1.7343	1.301	344.5	1.4060	6.44	26.80
1.7139	1.485	329.6	1.4836	8.72	3.654
1.5606	3.488	190.5	1.4861	9.09	3.656
1.5525	3.663	180.2	—	13.17	2.11

ZIRCONIUM Tetra CHLORIDE ZrCl_4 .

SOLUBILITY OF ZIRCONIUM TETRA CHLORIDE IN LIQUID SULFUR DIOXIDE.
(Bond and Stephens, 1929.)

A monel metal bomb having two chambers communicating by means of a
needle valve, was used.

t°	Gm. Mol. ZrCl_4 per 1.0 mol. $\text{ZrCl}_2 + \text{SO}_2$
0	0.0138
10	0.0199
20	0.0258

ZIRCONIUM Oxy CHLORIDE $\text{ZrOCl}_2 \cdot 8\text{H}_2\text{O}$.

SOLUBILITY OF ZIRCONIUM OXYCHLORIDE IN AQUEOUS HYDROCHLORIC ACID AT 20°. F
(v. Hevesy, 1925.)

Constant agitation for many hours was employed. The zirconium oxychloride
contained 0.4 % oxide of hafnium. The solid phase was $\text{ZnOCl}_2 \cdot 8\text{H}_2\text{O}$ up to
concentrations of 10 normal HCl.

Normality of Aq. HCl.	Gms. ZrO_2 per liter sat. sol.	Mols. ZrOCl_2 per liter sat. sol.	Normality of Aq. HCl	Gms. ZrO_2 per liter sat. sol.	Mols. ZrOCl_2 per liter sat. sol.
0.29....	358.1	2.91	6.35....	12.78	0.1037
1.47....	264.5	2.14	8.72....	6.74	0.0547
3.72....	102.2	0.832	10.14....	12.17	0.0988
4.97....	40.5	0.329	10.94....	25.3	0.205
5.81....	19.35	0.157	11.61....	41.1	0.334

ZIRCONIUM Oxy FLUORIDE $\text{ZrOF}_2 \cdot 2\text{HF} \cdot 2\text{H}_2\text{O}$.

SOLUBILITY OF ZIRCONIUM OXYFLUORIDE IN AQUEOUS SOLUTIONS OF
HYDROFLUORIC ACID AT 25°. F
(v. Hevesy and Wagner, 1930.)

d. of sat. sol.	Normality of aq. HF	Gms. ZrO_2 per liter sat. sol.	d. of sat. sol.	Normality of aq. HF	Gms. ZrO_2 per liter sat. sol.
1.489	0	408.5	1.685	10.05	548.5
1.559	1.06	502.2	1.600	15.05	444.3
1.712	6.03	571.8	1.430	20.09	288.3

The salt $\text{ZrF}_4 \cdot 3\text{H}_2\text{O}$ crystallizes from aqueous hydrofluoric acids of
concentrations between 5.0 and 20.0 normal.

ZIRCONIUM

1598

ZIRCONIUM Potassium Hexa **FLUORIDE** $\text{Zr K}_2\text{F}_6$.

SOLUBILITY OF ZIRCONIUM POTASSIUM HEXA FLUORIDE IN AQUEOUS SOLUTIONS OF HYDROFLUORIC ACID AT 20°.

(v. Hevesy, 1925; v. Hevesy, Christiansen and Berglund, 1925.)

Normality of aq. HF.....	0.125	5.89
Mols. $\text{Zr K}_2\text{F}_6$ per liter.....	0.0655	0.1298

ZIRCONIUM Ammonium **FLUORIDES** $\text{Zr}(\text{NH}_4)_2\text{F}_6$ and $\text{Zr}(\text{NH}_4)_3\text{F}_7$.

SOLUBILITY OF EACH SEPARATELY IN WATER.

(v. Hevesy, 1925; v. Hevesy, Christiansen and Berglund, 1925.)

The solutions were saturated by constant shaking in a thermostat.

Compound.	t°.	d of sat. sol.	Mol. per liter sat. sol.	
			Zr.	NH_3 .
Zirconium Ammonium Hexa Fluoride $\text{Zr}(\text{NH}_4)_2\text{F}_6$...	0	—	0.611	1.226
„ „ „ „ „ „ ...	20	1.154	1.050	2.115
„ „ „ „ „ „ ...	45	—	1.842	3.680
„ „ „ „ „ „ ...	90	—	2.96	5.93
„ „ Hepta „ „ $\text{Zr}(\text{NH}_4)_3\text{F}_7$...	0	—	0.425	1.230
„ „ „ „ „ „ ...	20	1.086	0.588	1.756
„ „ „ „ „ „ ...	45	—	0.788	2.357

SOLUBILITY OF ZIRCONIUM AMMONIUM HEPTA FLUORIDE IN AQUEOUS SOLUTIONS OF AMMONIUM FLUORIDE AT 20°.

(v. Hevesy, 1925; v. Hevesy, Christiansen and Berglund, 1925.)

The mixtures were constantly agitated in a flask of ebonite.

d of sat. sol.	Mols. per liter			Solid Phase.
	NH_4F .	NH_3 (attached to Zr).	Zr.	
1.086	0.002	1.655	0.551	$\text{Zr}(\text{NH}_4)_3\text{F}_7$
—	0.462	1.125	0.375	„
—	0.966	0.726	0.242	„
—	1.941	0.292	0.0972	„
1.068	4.872	0.0678	0.0226	„
1.105	9.721	0.0515	0.01716	„

SOLUBILITY OF ZIRCONIUM AMMONIUM FLUORIDE IN AQUEOUS SOLUTIONS OF ZIRCONIUM AMMONIUM HEXA FLUORIDE AT 20° AND VICE VERSA.

(v. Hevesy, 1925; v. Hevesy, Christiansen and Berglund, 1925.)

Mols. per liter (found)		Mols. per liter (calculated)		Solid Phase.
Zr.	NH_3 .	$\text{Zr}(\text{NH}_4)_2\text{F}_6$.	$\text{Zr}(\text{NH}_4)_2\text{F}_6$.	
0.551	1.655	0.551	0.0	$\text{Zr}(\text{NH}_4)_3\text{F}_7$
0.733	1.831	0.365	0.368	„
1.109	2.383	0.165	0.944	„ + $\text{Zr}(\text{NH}_4)_2\text{F}_6$
1.050	2.115	0.0	1.05	$\text{Zr}(\text{NH}_4)_2\text{F}_6$

ZIRCONIUM NITRATE $\text{Zr}(\text{NO}_3)_4$.

100 cc of a saturated solution of zirconium-nitrate in ethyl ether, prepared by frequent agitation and allowing to stand over night at about 20°, contain 0.003 gm. ZrO_2 . A saturated ethereal solution prepared as above, but using zirconium nitrate which had been dehydrated at 150°, contain 0.004 gm. ZrO_2 per 100 cc. (Wells, 1930.)

ZIRCONIUM PHOSPHATE $\text{ZrO}(\text{H}_2\text{PO}_4)_2$,

SOLUBILITY OF ZIRCONIUM PHOSPHATE IN AQUEOUS HYDROCHLORIC ACID AT 20°.
(v. Hevesy and Kimura, 1925.)

About 0.1 gm. of the compound was shaken with about 150 cc. of the hydrochloric acid in a thermostat for 3 days. 100 cc. of the sat. solution were evaporated and the residue ignited.

Normality of aq. HCl.	Gms. ignited residue from 100 cc. sat. sol.	Mol. $\text{ZrO}(\text{H}_2\text{PO}_4)_2$ per liter sat. sol.
6.01.....	0.0033	0.00012
10.00.....	0.0061	0.00023

ZIRCONIUM SULFATE $\text{Zr}(\text{SO}_4)_2$.

SOLUBILITY OF ZIRCONIUM SULFATE IN AQUEOUS SULFURIC ACID AT 37.5°.
(Hauser, 1907.)

Gms. per 100	Gms. Sat. Sol.	Solid Phase.	Gms. per 100	Gms. Sat. Sol.	Solid Phase.
ZrO_2 .	SO_3 .		ZrO_2 .	SO_3 .	
19.5	25.46	$\text{Zr}(\text{SO}_4)_{2.4}\text{H}_2\text{O}$	0.15	56.7	$\text{Zr}(\text{SO}_4)_{2.4}\text{H}_2\text{O}$
18.8	27	"	0.50	57.5	"
16.2	29.1	"	2	59.5	"
9.6	32.3	"	4.4	61.4	" + $\text{Zr}(\text{SO}_4)_2 \cdot \text{H}_2\text{SO}_4 \cdot 3\text{H}_2\text{O}$
5.3	34.7	"	4.55	61.5	$\text{Zr}(\text{SO}_4)_2 \cdot \text{H}_2\text{SO}_4 \cdot 3\text{H}_2\text{O}$
3.51	36.01	"	3.33	63.8	"
1.03	38.2	"	1.80	64.2	"
0.46	39.8	"	1.12	66.8	"
0.33	42.1	"	0.96	68.4	"
0.14	46.8	"	0.10	81.5	$\text{Zr}(\text{SO}_4)_2 \cdot \text{H}_2\text{SO}_4 \cdot \text{H}_2\text{O}$

SO

Results at 22° show only slight differences from the above figures, hence, the temperature coefficient for this salt is quite small. In an earlier paper Hauser (1905) gives data for the basic sulfate $4\text{ZrO}_2 \cdot 3\text{SO}_3 \cdot 14\text{H}_2\text{O}$.

Using mixtures composed of 10 gms. of $\text{ZrOCl}_2 \cdot 8\text{H}_2\text{O}$ and 16 to 30 cc portions of conc. sulfuric acid ($d = 1.83$) at 25° Falinski, 1936, obtained a new acid zirconium sulfate of the composition $\text{Zr}(\text{SO}_4)_2 \cdot \text{H}_2\text{SO}_4 \cdot 2\text{H}_2\text{O}$.

ZIRCONIUM Thallium SULFATE.

SOLUBILITY OF ZIRCONIUM THALLIUM SULFATE IN AQUEOUS 20 PER CENT
SULFURIC ACID. (Fernandez, 1925.)

A solution of zirconium sulfate in aqueous sulfuric acid of about 20 per cent concentration was saturated with thallium sulfate at 100° and this solution cooled to several constant temperatures and the weight of ZrO_2 present at each temperature determined. The following three double salts are described, $\text{Zr}(\text{SO}_4)_2 \cdot 2\text{Tl}_2\text{SO}_4 \cdot 4\text{H}_2\text{O}$; $2\text{Zr}(\text{SO}_4)_2 \cdot \text{Tl}_2\text{SO}_4 \cdot 8\text{H}_2\text{O}$ and $2\text{Zr}(\text{SO}_4)_2 \cdot 7\text{Tl}_2\text{SO}_4$. The particular one in contact with each saturated solution is not designated.

t°.	Gms. ZrO_2 per 100 cc. H_2O .	t°.	Gms. ZrO_2 per 100 cc. H_2O .	t°.	Gms. ZrO_2 per 100 cc. H_2O .
0.....	0.62	40.....	0.85	80.....	2.45
10.....	0.62	50.....	1.15	90.....	2.88
20.....	0.65	60.....	1.57	100.....	3.20
30.....	0.72	70.....	2.02		

AUTHOR INDEX

- Abbott, G. A. and Bray, W. C.
(1909) J. Am. Chem. Soc., **31**, 729-63
- Abe, Ryuji.
(1911) Mem. Coll. Sci. Eng. (Kyoto),
3, 212.
(1911) J. Tok. Chem. Soc., **32**, 980.
(1911-12) Mem. Coll. Sci. Eng.
(Kyoto), **3**, 13.
(1912) J. Tok. Chem. Soc., **33**, 1087.
- Abegg, R.
(1903) Z. Elektrochem., **9**, 550.
- Abegg, R. and Cox, A. J.
(1903) Z. physik. Chem., **46**, 11.
- Abegg, R. and Pick, H.
(1905) Ber., **38**, 2573.
(1906) Z. anorg. Chem., **51**, 1.
- Abegg, R. and Riesenfeld, H.
(1902) Z. physik. Chem., **40**, 84.
- Abegg, R. and Sherrill, M. S.
Z. Elektrochem., **9**, 550.
- Abegg, R. and Spencer.
(1905) Z. anorg. Chem., **46**, 406.
- Abel, E. and Proisl, J.
(1929) Z. Elektrochem., **35**, 712-15.
- Achumow, E. I. and Wassilijew, B. B.
(1932) Zhurnal Obs. Khimii, **2**, 271-89.
- Adams, L. H.
(1931) J. Am. Chem. Soc., **53**, 3769-3813.
(1932) J. Am. Chem. Soc., **54**, 2229-40.
- Adams, L. H. and Gibson, R. E.
(1932) J. Am. Chem. Soc., **54**, 4520-37.
- Adams, L. H. and Hale, R. C.
(1931) J. Wash. Acad. Sci., **21**, 183-194.
- Adeney, W. E. and Becker, H. C.
(1916-20) Sci. Proc. Roy. Soc. (Dublin),
15, 385, 609.
(1919) Phil. Mag., **38**, 317-37.
(1920) Phil. Mag., **39**, 384-404.
(1921) Phil. Mag., **42**, 87-96.
- Adolff and Hering, H.
(1934) Compt. rend., **198**, 1770.
- Agde, G. and Barkholt, H.
(1926) Z. angew. Chem., **39**, 851-5.
(1927) Z. angew. Chem., **40**, 378.
- Agde, G. and Schimmel
(1928) Z. angew. Chem., **41**, 340.
- Agno, F. and Valla, E.
(1911) Atti accad. Lincei, **20**, II, 706.
(1912) Ist. Ven. [VIII], **14**, II, 331.
(1913) Gazz. chim. ital., **43**, II, 168.
- Agnew, N. and Sachs, G.
(1930) Z. Physik. Chem. **63**, 293
- d' Agostino, E.
(1910) Rend. soc. chim. ital. (Roma),
2, II, 171.
- Ahrens, U.
(1930) Dissertation, Braunschweig
- Aita, A.
(1916) Ann. chim. applicata, **6**, 28-44,
119-31
(1917) Ann. Chim. applicata, **7**, 200.
- Akerlof, Gosta
(1935) J. Am. Chem. Soc., **57**, 1196-1201.
- Akerlof, G. and Short, O.
(1937) J. Am. Chem. Soc., **59**, 1912-15.
- Akerlof, G., Teare, J. W. and Turck, H.
(1937) J. Am. Chem. Soc., **59**, 1916-20
- Akerlof, G. and Thomas, H. C.
(1934) J. Am. Chem. Soc., **56**, 593-601.
- Akerlof, G. and Turck, H. E.
(1935) J. Am. Chem. Soc., **57**, 1746-50.
- Akhomow, E. I. and Eserowa, E. A.
(1936) Zhurnal Obs. Khimii, **6**, 1418-29
- Aldrich, E. W.
(1931) Ind. Eng. Chem., (Anal. Ed.)
3, 348.
- Alekceevskij, E. V.
(1921) J. Russ. Phys. Chem. Soc.,
53, 326-31.
- Alexejew, Wladimir. (Alexejeff.)
(1886) Wied. Ann. Physik., **28**, 305, 338.
- Allen, E. T. and White, W. P.
(1909) Am. Jour. Sci., **27**, 1.
- Alleman, E.
(1928) Verslag Chemie. (Berlin)
- Allmand, A. J. and Burrage, L. J.
(1933) Trans. Faraday Soc., **29**, 679-89.
- Almkvist, G.
(1918) Z. anorg. allgem. Chem., **103**, 240.
- Altschul.
(1896) Monatsch. Chem., **17**, 575.

AUTHOR INDEX

- Alluard.**
 (1864) *Compt. rend.*, **59**, 500.
 (1865) *Liebig's Ann.*, **133**, 292.
- Amadori, M.**
 (1912) *Atti accad. Lincei*, **21**, **II**, 67, 184, 769, 690.
 (1912a) *Atti accad. Lincei*, **21**, **I**, 467, 667-73.
 (1913) *Atti accad. Lincei*, **22**, **I**, 453, 609; **22**, **II**, 333.
 (1915) *Atti accad. Lincei*, **24**, **II**, 204.
 (1916-17) *Atti Ist. Ven.*, **76**, **II**, 419-33.
 (1918) *Gazz. chim. ital.*, **48**, **II**, 42-53.
 (1918) *Atti accad. Lincei*, **5**, **27**, **I**, 131-3, 143.
 (1919) *Gazz. chim. ital.*, **49**, **I**, 38-68.
 (1919) *Atti Ist. Ven.*, **79**, 293.
 (1922) *Gazz. chim. ital.*, **52**, **I**, 387-94.
- Amadori, M. and Becarelli, R.**
 (1912) *Atti accad. Lincei*, **21**, **II**, 698.
- Amadori, M. and Pampanini, G.**
 (1911) *Atti accad. Lincei*, **20**, **II**, 475, 572.
- Amat, L.**
 (1887) *Compt. rend.*, **105**, 809.
- Anders, Otto.**
 (1933) *Z. physik. Chem. (A)*, **164**, 145-75.
- Anderson.**
 (1888-89) *Proc. Roy. Soc. (Edin.)*, **16**, 319.
- Anderson, J. T.**
 (1932) *J. Phys. Chem.*, **36**, 2145-65.
- Anderson, E. and Nestell, R. I.**
 (1920) *Ind. Eng. Chem.*, **12**, 243-6.
- Anderson, E. and Story, L. G.**
 (1923) *J. Am. Chem. Soc.*, **45**, 1104.
- Anderson, L. H. and Yost, D. M.**
 (1938) *J. Am. Chem. Soc.*, **60**, 1822-5.
- Ando, K.**
 (1925) *Mem. Coll. Sci. Kyoto Imp. Univ.* (A), **8**, 283-6.
- Andrae.**
 (1884) *J. prakt. Chem.* [2], **29**, 456.
- Andrews, L. W. and Ende, C.**
 (1895) *Z. physik. Chem.*, **17**, 136.
- Ange, see Augé.**
- Anon.**
 (1903) *Bull. soc. pharm. (Bordeaux)*, p. 7.
 (1904) *Pharm. Jour. (Lond.)*, **72**, 77.
- d'Ans see D'Ans.**
- Anschutz, R., Kallen, J. and Riepenkröger, K.**
 (1919) *Ber.*, **52B**, 1860-75.
- Anthony, C. G.**
 (1916) *Bonfort's Wine and Spirit Circular*, Apr. 10th.
- von Antropoff, A.**
 (1909-10) *Proc. Roy. Soc. (London)*, **A 83**, 474-83.
 (1919) *Z. Elektrochem.*, **25**, 269-97.
 (1924) *Z. Elektrochem.*, **30**, 457-67.
- von Antropoff, A. and Sommer, W.**
 (1926) *Z. physik. Chem.*, **123**, 161-198.
- Apfel, Otto.**
 (1911) *Dissertation, Technischen Hochschule, Darmstadt.*
- Applebey, M. P. and Crawford, F. H.**
 (1934) *J. Chem. Soc. (Lond)* 1665-71.
- Applebey, M. P. and Lane, K. W.**
 (1918) *J. Chem. Soc.*, **113**, 614-22.
- Applebey, M. P. and Leishman, M. A.**
 (1932) *J. Chem. Soc. (Lond.)* 1603-08.
- Applebey, M. P. and Powell, H. M.**
 (1931) *J. Chem. Soc. (Lond)* 2821-9.
- Applebey, M. P. and Reid, R. D.**
 (1922) *J. Chem. Soc.*, **121**, 2129-36.
- Applebey, M. P. and Wilkes, S. H.**
 (1922) *J. Chem. Soc.* **121**, 337-48.
- Applebey, M. P. and Windridge, E. D.**
 (1932) *J. Chem. Soc. (Lond)* 1608-13.
- Araki, S.**
 (1925) *Mem. Coll. Sci. Kyoto Imp. Univ. (A.)*, **8**, 219-22.
- Archibald, E. H. and Gale, W. A.**
 (1924) *J. Am. Chem. Soc.*, **46**, 1760-71.
- Archibald, E. H. and Habasian, Y.**
 (1917) *Trans. Roy. Soc. (Canada)*, [3], **11** (Sec. 111), 1-6.
- Archibald, E. H. and Hallett, L. T.**
 (1925) *J. Am. Chem. Soc.*, **47**, 1314-18.
- Archibald, E. H. and Kern, J. W.**
 (1917) *Trans. Roy. Soc. (Canada)*, [3], **11** (Sec. 111), 7-16.
- Archibald, E. H., Wilcox, W. G. and Buckley, B. G.**
 (1908) *J. Am. Chem. Soc.*, **30**, 747-60.

AUTHOR INDEX

Hibald, R. C.

(1932) J. Am. Chem. Soc., **54**, 3178

owski, H.

(1894) Z. anorg. Chem., **6**, 267, 404.

(1895) Compt. rend., **121**, 123.

(1895-6) Z. anorg. Chem., **11**, 272-4.

itti, R.

(1933) Compt. rend., **196**, 1388,

197, 1209.

o, W. L., James, E. M. and Donnelly, J. L.

(1919) J. Phys. Chem., **23**, 578-85.

i, K.

(1932) Sci. Reports Tohoku Univ.,

(1), **21**, 783.

kadiiev, V.

(1918) J. Russ. Phys. Chem. Soc., **50**,

205-9.

nit, H. W.

(1907) Jour. Hygiene, **7**, 525-51.

strong, H. E. and Eyre, J. V.

(1910-11) Proc. Roy. Soc. (London), (A),

84, 123-35.

(1913) Proc. Roy. Soc. (London), (A), **88**,

234.

strong, H. E., Eyre, J. V., Hussey, A. V.,

and Paddison, W. P.

(1907) Proc. Roy. Soc. (London), (A),

79, 564-76.

my Air Corps.

(1922) Air Service Inf. Cir. 320

ndt, K.

(1907) Ber., **40**, 427.

ndt, K. and Loewenstein, W.

(1909) Z. Elektrochem., **15**, 784-90.

onowa, S. I., and Lunskaia, S. N.

(1931) Shurn. Chimitscheskor,
Promyshlewnosti, **8**,

(No. 18), 23.

(1933) Kali(russ), **2**, 24.

rhenius, S.

(1893) Z. physik. Chem., **11**, 396.

rth, G. and Cretien.

(1906) Bull. soc. chim. [3], **35**, 778.

rtmann, P.

(1912-13) Z. anorg. Chem., **79**, 333.

(1915) Z. anal. Chem., **54**, 90.

Aschan, Ossian.

(1913) Chem. Ztg., **37**, 1117.

Ashton, F. W., Houston, D. F. and Saylor, C. P.

(1933) J. Res. U. S. Bureau of Standards,

11, 233-53.

Askenasy, P. and Neisler, F.

(1930) Z. anorg. Chem., **189**, 305-28.

Askew, H. O.

(1923) Trans. New Zealand Inst., **54**,

791-6.

Assarason, G.

(1931) Z. anorg. Chem. **200**, 385.

Asselin, E.

(1873) Compt. rend., **76**, 884.

(1873) Jahresber. Chem., 1063.

Aten, A. H. W.

(1905) Z. anorg. Chem., **47**, 387.

(1905-06) Z. physik. Chem., **54**, 86, 124.

(1909) Z. physik. Chem., **68**, 41.

(1912) Proc. K. Akad. Wet. (Amst.), **15**, 572.

(1912-13) Z. physik. Chem., **81**, 268.

(1913) Z. physik. Chem., **83**, 443.

(1914) Z. physik. Chem., **86**, 1-35.

(1914a) Z. physik. Chem., **88**, 321-79.

(1918) Proc. Acad. Sci. (Amsterdam), **20**,
824.

Atkins, W. R. G.

(1924) Nature, **114**, 275.

Atkins, W. R. G. and Werner, E. A.

(1912) J. Chem. Soc. (Lond.), **101**, 1167.

Atkinson, R. H., Heycock, C. T. and Pope, W. J.

(1920) J. Chem. Soc., **117**, 1422.

Atsuki, K. and Isshi, N.

(1931) J. Soc. Chem. Ind. (Japan), **34**, 331.

Aubert, A. B.

(1902) J. Am. Chem. Soc., **24**, 690.

Auerbach, F.

(1903) Z. anorg. Chem., **37**, 353-77.

(1904) Z. Elektrochem., **10**, 163.

Auerbach, F. and Barschall, H.

(1908) Arb. Kais. Gesundheitsamt., **27**,
183-230.

(1908) Chem. Abs., **2**, 1125.

Auerbach, F. and Weber, H.

(1925) Z. anorg. allgem. Chem., **147**, 68-80.

Auge, E.

(1890) Compt. rend., **110**, 1139.

AUTHOR INDEX

- Auger, V.**
(1923) *Compt. rend.*, **177**, 1302.
- Aumeras, M.**
(1927) *J. chim. phys.*, **24**, 24-49.
(1927a) " " **24**, 548-571.
- Baars, ,**
(1927) *Samml. Chem. u. chem. techn. Vortr.*, **29**, 304.
- de Baat, W. C.**
(1918) *Chem. Weekblad*, **15**, 463-8.
(1923) *Rec. trav. chim.*, **42**, 643-46.
(1926) *Rec. trav. chim.*, **45**, 237-44.
- Babaewa, A. W. (Babaev, Babajewa)**
(1931) *U. S. S. R. Scient. techn. Depart. Supr. Council Nat. Economy No. 420*, p. 114. *Trans. Inst. pure Chem. Reagents*, No. 11
(1936) *Zhurnal Obs. Khimii*, **6**, 1144-6.
- Babaewa, A. W., and Archako, T. A.**
(1935) *Zhurnal Obs. Khimii*, **5**, 216-9.
- Babaewa, A. W. and Daniluschkina, E. I.**
(1936) *Z. anorg. Chem.*, **226**, 338-40.
- Babaewa, A. W. and Klatchko-Gourvitch, L. P.**
(1935) *Zhurnal Obs. Khimii*, **5**, 220-3.
- Babko, A. K.**
(1935) *Z. anal. Chem.*, **103**, 190-6.
- Backer, H. J.**
(1927) *Z. physik. Chem.*, **130**, 177-83.
(1930) *Rec. trav. chim.*, **49**, 730.
- Backer, H. J. and Terpstra, P.**
(1929) *Rec. trav. chim.*, **48**, 952, 1175.
- Bäckström, H. L. J.**
(1921) *Z. physik. Chem.*, **97**, 213.
(1921) *Medd. Vetenskapsakad. Nobel Inst.*, **4**, No. 11.
- Bahr, F.**
(1911) *Z. anorg. Chem.*, **71**, 85.
- Bailar, John, C. Jr.,**
(1931) *Ind. Eng. Chem. (Anal. Ed.)*, **3**, 362-3
- Bailey, Chas. R.**
(1930) *J. Chem. Soc. (Lond.)*, 1534-9.
- Bailey, K. C. and Hilton, J.**
(1936) *J. Chem. Soc. (Lond.)*, 1571.
- Bailly, O.**
(1916) *Ann. chim.*, [9], **6**, 96-155, 240.
(1919) *Bull. soc. chim.*, [4], **25**, 240-60.
- Bailly, O. and Gaume, J.**
(1924) *Bull. soc. chim.*, **4**, 35, 594-6.
- Bain, J. W.**
(1927) *J. Am. Chem. Soc.*, **49**, 2734-8
- Bakke, B.**
(1914) *Dissertation, Technischen Hochschule, Berlin.*
- Bakunin, M. and Vitale, E.**
(1935) *Gazz. chim. ital.*, **65**, 593-616.
- Balarew, D.**
(1925) *Z. anorg. allgem. Chem.*, **145**, 122-6.
- Balcar, F. R. and Stegmann, G.**
(1928) *J. Phys. Chem.*, **32**, 1411-21.
- Baly.**
(1900) *Phil. Mag.* [5], **49**, 517.
- Bancroft, W. D. and Gould, L. P.**
(1934) *J. Phys. Chem.*, **38**, 205.
- Bancroft, W. D., Scherer, G. A. and Gould, L. P.**
(1931) *J. Phys. Chem.*, **35**, 764-785.
- Banthisch.**
(1884) *J. prakt. Chem.*, [2], **29**, 54.
- Barkan, G.**
(1924) *Biochem. Z.*, **146**, 446-57.
- Barker, T. V.**
(1908) *J. Chem. Soc. (Lond.)*, 93, 15.
- Barnes, W. H. and Maass, O.**
(1930) *Canadian J. Res.*, **2**, 218-21.
- Baroni, A.**
(1934) *Atti accad. Lincei* [6], **20**, 384-90.
- Barre, M.**
(1909) *Compt. rend.*, **148**, 1604-6; **149**, 292.
(1910) *Compt. rend.*, **150**, 1321, 1599; **151**, 871-3.
(1911) *Ann. chim. phys.*, [8], **24**, 149-67, 202, 210-23.
(1912) *Bull. soc. chim.*, [4], **11**, 646.
- Basch.**
(1901) *Dissertation (Berlin)*, p. 17.
- Baskerville, C. and Cohen, P. W.**
(1921) *Ind. Eng. Chem.*, **13**, 333.
- Baskerville, W. H. and Cameron, F. K.**
(1935) *J. Phys. Chem.*, **39**, 769-79.
- Baskov, A.**
(1915) *J. Russ. Phys. Chem. Soc.*, **47**, 1533-5.
(1917) *Bull. soc. chim.*, (France) [4], **22**, 65.

AUTHOR INDEX

- Bassett, H. Jr.**
 (1908) Z. anorg. Chem., 59, 1-55.
 (1917) J. Chem. Soc. (Lond.), 111, 620-42.
 (1934) J. Chem. Soc. (Lond.), 1270-5.
- Bassett, H. and Bagnall, D. J. T.**
 (1924) J. Chem. Soc., 125, 1366-73.
- Bassett, H., Barton, G. W., Foster, A. R. and Pateman, R. J.**
 (1933) J. Chem. Soc., 151-165.
- Bassett, H. and Bedwell, W. L.**
 (1931) J. Chem. Soc., 2479-2492.
- Bassett, H. and Corbet, A. S.**
 (1924) J. Chem. Soc., 125, 1660-75.
- Bassett, H. and Dode, M.**
 (1936) Compt. rend., 203, 775-7.
- Bassett, H., Gordon, H. F. and Henshall, J. H.**
 (1937) J. Chem. Soc. (Lond.), 56, 971-3.
- Bassett, H. and Halton, P.**
 (1923) J. Chem. Soc., 125, 1291-1304.
- Bassett, H. and Harry, H.**
 (1930) J. Chem. Soc. (Lond.), 1784-1819.
- Bassett, H., Henry, and Lemon, J. T.**
 (1933) J. Chem. Soc. (Lond.), 1423-7.
- Bassett, H., Henshall, J. H. and Sargeant, G. A.**
 (1939) J. Chem. Soc. (Lond.), 653-60.
- Bassett, H., Henshall, J. H., Sergeant, G. A., and Shipley, R. H.**
 (1939) J. Chem. Soc. (Lond.), 646-53.
- Bassett, H. and Sanderson, I.**
 (1932) J. Chem. Soc. (Lond.), 1855-1864.
 (1934) J. Chem. Soc. (Lond.), 1116-1120.
- Bassett, H. Jr. and Taylor, H. S.**
 (1912) J. Chem. Soc. (Lond.), 101, 576.
 (1914) J. Chem. Soc. (Lond.), 105, 1926-41.
- Bathrick.**
 (1896) J. Phys. Chem., 1, 159.
- Baubigny, H.**
 (1908) Bull. soc. chim., 543, 3, 772.
 (1908) Compt. rend., 146, 1263.
- Baume, G.**
 (1911) J. chim. phys., 9, 245.
 (1914) J. chim. phys., 12, 216.
- Baume, G. and Borowski, W.**
 (1914) J. chim. phys., 12, 276-81.
- Baume, G. and Georgitses, N.**
 (1912) Compt. rend., 154, 650.
 (1914) J. chim. phys., 12, 250.
- Baume, G. and Germann, F. O.**
 (1911) Compt. rend., 153, 569
 (1914) J. chim. phys., 12, 242.
- Baume, G. and Pamfil, G. P.**
 (1911) Compt. rend., 152, 1095.
 (1914) J. chim. phys., 12, 256.
- Baume, G. and Perrot, F. L.**
 (1911) Compt. rend., 152, 1763-5.
 (1914) J. chim. phys., 12, 225.
- Baume, G. and Robert, N.**
 (1919) Compt. rend., 169, 968.
- Baume, G. and Tykociner, A.**
 (1914) J. chim. phys., 12, 270-5.
- Baup.**
 (1858) Ann. chim. phys., 33, 53, 468.
- Baur, Emil.**
 (1926) Z. Elektrochem., 32, 428-30.
- Bayley, C. H. and Hopkins, C. Y.**
 (1934) Canadian J. Res. 11, 505-19.
- Baxter, G. P.**
 (1907) J. Am. Chem. Soc., 29, 129.
- Baxter, G. P., Boylston, A. C. and Hubbard, R. A.**
 (1906) J. Am. Chem. Soc., 28, 1343.
- Baxter, G. P. and Grose, M. R.**
 (1915) J. Am. Chem. Soc., 37, 1061.
- Baxter, W. P.**
 (1926) J. Am. Chem. Soc., 48, 615-21.
- Beach, H. T. and Bond, P. A.**
 (1925) Proc. Iowa Acad. Sci., 32, 328.
- Beans, H. T. and Oakes, E. T.**
 (1920) J. Am. Chem. Soc., 42, 2116-31.
- Beck, K. and Stegmüller, Ph.**
 (1910) Arb. Kais. Gesundheitsamt., 34, 447.
 (1911) Z. Elektrochem., 17, 843-48.
- Beckmann, E. and Stock, A.**
 (1895) Z. physik. Chem., 17, 130.
- Bedel, Chas.**
 (1937) Compt. rend. 204, 1651-3.
 (1938) Compt. rend. 207, 632-4

AUTHOR INDEX

- Behrend, R.**
(1893) Z. physik. Chem., **11**, 466.
- Bell, H. C.**
(1923) J. Chem. Soc., **123**, 2713.
- Bell,**
(1867) Chem. News., **16**, 69.
- Bell, J. M.**
(1905) J. Phys. Chem., **9**, 544.
(1911) J. Am. Chem. Soc., **33**, 940.
- Bell, J. M. and Buckley, M. L.**
(1912) J. Am. Chem. Soc., **34**, 10.
- Bell, J. M. and Spry, F. H.**
(1921) Ind. Eng. Chem., **13**, 308.
- Bell, J. M. and Taber, W. C.**
(1906) J. Phys. Chem., **10**, 119.
(1907) J. Phys. Chem., **11**, 637-8.
(1908) J. Phys. Chem., **12**, 174.
- Bell, R. P.**
(1930) Z. physik. Chem. (A), **150**, 20-30.
(1931) J. Chem. Soc. (Lond.), 1371-1382.
- Bell, W. R. G., Rowlands, C. B., Bamford, J. J., Thomas, W. G. and Jones, W. J.**
(1930) J. Chem. Soc. (Lond.), 1927-31.
- Belladen, L.**
(1922) Gazz. chim. ital., **52**, **11**, 160-4.
- Bellucci, I.**
(1912) Atti accad. Lincei, [5], **21**, **11**, 610.
(1913) Gazz. chim. ital., **43**, **1**, 521.
- Bellucci, I., and Grassi, L.**
(1913) Atti accad. Lincei, [5], **22**, **11**, 676.
(1914) Gazz. chim. ital., **44**, **1**, 559.
- Belopokki, A. P.**
(1933) Chem. Jour. Ser. B., J. Angew. Chem. Russ. Chimit Shurn, Ser. B., Shurn prikladnoi Chim, **6**, 397.
- Bennett, W. H.**
(1932) Trans. Faraday Soc., **28**, 889.
- Benrath, A.**
(1924) Z. anorg. allgem. Chem., **135**, 248-54.
(1924) Z. anorg. allgem. Chem., **136**, 358-66.
(1926) Z. anorg. allgem. Chem., **151**, 343-8.
(1927) Z. anorg. Chem., **163**, 396-404.
(1928) Z. anorg. Chem., **170**, 257.
(1929) Caliche, **11**, 99.
(1929a) Z. anorg. Chem., **183**, 296-300.
(1930) Z. anorg. Chem., **189**, 82-90.
(1931) Z. anorg. Chem., **202**, 161-71.
(1931a) Z. anorg. Chem., **195**, 247-54.
(1932) Z. anorg. Chem., **208**, 169.
- Benrath, A. and Ammer, G.**
(1929) Z. anorg. Chem., **177**, 129-36.
- Benrath, A. and Benrath, H.**
(1929) Z. anorg. Chem., **179**, 369-78.
(1929a) Z. anorg. Chem., **184**, 359-68.
(1930) Z. anorg. Chem., **189**, 72-81.
- Benrath, A. and Blankenstein, A.**
(1934) Z. anorg. Chem., **216**, 41-48.
(1934a) Z. anorg. Chem., **217**, 170-174.
- Benrath, A. and Espenschied, H.**
(1922) Z. anorg. allgem. Chem., **121**, 361-72.
- Benrath, A., Gjedebø, F., Schiffers, B. and Wunderlich, H.**
(1937) Z. anorg. Chem., **231**, 285-97.
- Benrath, A. and Neumann.**
(1938-9) Z. anorg. Chem., **240**, 80-86.
- Benrath, A. and Ritter, G.**
(1939) J. prakt. Chem., **152**, 177-89.
- Benrath, A. and Schackmann, H.**
(1934) Z. anorg. Chem., **218**, 139-45.
(1935) Z. anorg. Chem., **221**, 418-22.
- Benrath, A. and Schiffers, B.**
(1938) Z. anorg. Chem., **240**, 67-79.
- Benrath, A. and Schröder, W.**
(1924) Z. anorg. allgem. Chem., **135**, 205-25.
- Benrath and Sichel Schmidt, A.**
(1931) Z. anorg. Chem., **197**, 113-28.
- Benrath, A. and Thiemann, W.**
(1932) Z. anorg. Chem., **208**, 177-93.
(1934) Z. anorg. Chem., **217**, 347-52.
(1935) Z. anorg. Chem., **221**, 423-6.
- Benrath, A. and Thönnessen, C.**
(1932) Z. anorg. Chem., **203**, 405-16.
- Benrath, A. and Würzburger, A.**
(1924) Z. anorg. allgem. Chem., **135**, 226-32.
- Benrath, Hanna.**
(1932) Z. anorg. Chem., **205**, 421.
(1932a) Z. anorg. Chem., **205**, 417-424.
(1934) Z. anorg. Chem., **220**, 142-44.
(1934a) Z. anorg. Chem., **216**, 207.
(1934b) Z. anorg. Chem., **220**, 145-53.
(1938-9) Z. anorg. Chem., **240**, 87-96.
- Berg, Leo**
(1926) Z. anorg. Chem., **155**, 311.
(1930) Z. anorg. Chem., **181**, 121-6.

AUTHOR INDEX

- Bergius, F.**
(1910) Z. physik. Chem., 72, 338-61.
- Bergman, A. G.**
(1921) J. Russ. Phys. Chem. Soc., 53, 180-91.
(1922-4) J. Russ. Phys. Chem. Soc., 54, 200-18, 414-92, 625-37.
(1926) Z. anorg. allgem. Chem., 157, 83-116.
- Bergman, A. G., Genke, T. A. and Isaikin, F. M.**
(1922-4) J. Russ. Phys. Chem. Soc., 54, 466-73.
- Bergmann-Gönke**
(1926) Zhurnal Obs. Khimii, 58, 83.
- Berju and Kosminiko.**
(1904) Landw. Vers. Sta., 60, 422.
- Berkeley, Earl of.**
(1904) Phil. Trans. Roy. Soc. (Lond.), 203, A, 189-215.
- Berkeley, Earl of, and Appleby, M. P.**
(1911) Proc. Roy. Soc., 85, 503.
- Berl, E. and Saenger, H. H.**
(1929) Monatshefte Chem., 54, 1036-49.
- Bernardis, G. B.**
(1912) Atti accad. Lincei [5], 21, 11, 442.
- Bernfeld.**
(1898) Z. physik. Chem., 25, 72.
- Berthelot, M.**
(1904) Ann. Chim. phys. [8], 3, 146.
(1904) Compt. rend., 138, 1649.
- Bertisch, B.**
(1926) Roc. Chem., 6, 705-10.
- Bezner-Löwy, Miss Rosa.**
(1923) Bul. soc. chim. (Romania), 5, 81-2.
- Bertrand.**
(1868) Monit. Scientific [3], 10, 447.
- Bevade, J. (Bewad).**
(1884) Ber., 17, R., 406.
(1885) Bull. soc. chim. [2], 43, 123.
- Bhagwat, W. V. and Dhar, N. R.**
(1929) J. Indian Chem. Soc., 6, 807-22.
- Bibere, V. and Neumann, J.**
(1937) Zhurnal Obs. Khimii, 7, 2658-64.
- Billiter, J.**
(1920) Monatshefte Chem., 41, 287-95.
- Biltz, Wm. and Bräutigam, M.**
(1927) Z. anorg. Chem., 162, 49-56.
- Biltz, Wm. and Fischer, W.**
(1927) Z. anorg. Chem., 166, 290.
- Biltz, W. and Friedrich, H.**
(1924) Z. anorg. allgem. Chem., 136, 416-20.
- Biltz, W. and Marcus, E.**
(1911) Z. anorg. Chem., 71, 167.
- Biltz, W. and Meinecke, E.**
(1923) Z. anorg. allgem. Chem., 131, 1-21.
- Biltz, W. and Wilke-Dörfurt, E.**
(1906) Z. anorg. Chem., 48, 297-313.
- Binder, O.**
(1936) Ann. Chim., [11], 5, 337-85.
- Birckenbach, A. and Hüttner, K.**
(1930) Z. anorg. Chem., 190, 26.
- Birger, Carlson, see Carlson, Birger.**
- Biron.**
(1899) J. Russ. Phys. Chem. Soc., 31, 517.
- Bissell, D. W. and James, C.**
(1916) J. Am. Chem. Soc., 38, 873.
- Bjerrum, N. and Josefowicz, E.**
(1932) Z. physik. Chem. (A), 159, 194-222.
- Blarez.**
(1891) Compt. rend., 112, 434, 939, 1213.
- Blasdale, W. C.**
(1918) Ind. Eng. Chem., 10, 344-7.
(1920) Ind. Eng. Chem., 12, 164-7.
(1923) J. Am. Chem. Soc., 45, 2935.
- Blasdale, W. C. and Robson, H. L.**
(1928) J. Am. Chem. Soc., 50, 35-46.
- Blechts, F.**
(1919) Chemicke listy, Roc., 13, 125.
- Blumberg, J. B. and Zdanovskij, A. B.**
(1939) Zhurnal Obs. Khimii, 9, 814-8.
- Bobtelsky, M. and Malkowa-Janowski.**
(1927) Z. angew. Chem., 40, 1434-7.
- Bodländer, G.**
(1891) Z. physik. Chem., 7, 317, 361.
(1892) Z. physik. Chem., 9, 734.
(1898) Z. physik. Chem., 27, 66.
(1905) Z. angew. Chem., 18, 1138.
- Bodländer, G. and Eberlein, W.**
(1903) Ber., 36, 3948.
- Bodländer, G. and Fittig, R.**
(1901-02) Z. physik. Chem., 39, 597-612.

AUTHOR INDEX

- Bodländer, G. and Storbeck.**
(1902) *Z. anorg. Chem.*, **31**, 22, 460.
- Bodtker, E.**
(1897) *Z. physik. Chem.*, **22**, 510, 570.
- Boeke, H. E.**
(1907) *Z. anorg. Chem.*, **50**, 335.
(1908) *Z. Kryst. Min.*, **45**, 358.
(1908) *Ztrbl. Min. Geo. Pal.*, **23**, 710.
(1911) *N. Jahr. Min.*, **1**, 48, 61.
(1911) *Sitzber. k. Akad. Wiss. (Berlin)*, **24**, 632-8.
- de Boer, J. H. and van Liempt, J. A. M.**
(1927) *Rec. trav. Chim.*, **46**, 124.
- Bogdan, P.**
(1902-3) *Ann. Sci. Univ. Jassy*, **2**, 47.
(1905) *Z. Elektrochem.*, **11**, 825.
(1906) *Z. Elektrochem.*, **12**, 490.
- Bogitch, B.**
(1915) *Compt. rend.*, **161**, 790-1.
- Bogorodsky.**
(1894) *J. Russ. Phys. Chem. Soc.*, **26**, 209.
(1894) *Chem. Centralbl.*, **11**, 514.
- Bogousky.**
(1905) *J. Russ. Phys. Chem. Soc.*, **37**, 92.
- Bohr, C.**
(1899) *Wied. Ann. Physik.* [3], **68**, 503.
(1900) *Wied. Ann. Physik.* [4], **1**, 247.
(1910) *Z. physik. Chem.*, **71**, 47-50.
- Bohr, C. and Bock.**
(1891) *Wied. Ann. Physik.*, [2], **44**, 318.
- Boks.**
(1902) *Dissertation*, Amsterdam.
- Bollinger, G.**
(1928) *These*, Geneve.
- Bond, P. A. and Beach, H. T.**
(1926) *J. Am. Chem. Soc.*, **48**, 348-56.
- Bond, P. A. and Crone, E. B.**
(1934) *J. Am. Chem. Soc.*, **56**, 2028-31.
- Bond, P. A. and Stowe, V. M.**
(1931) *J. Am. Chem. Soc.*, **53**, 30-4.
- Bond, P. A. and Stephens, W. R.**
(1929) *J. Am. Chem. Soc.*, **51**, 2910-22.
- Bonnell, D. G. R. and Jones, W. J.**
(1926) *J. Chem. Soc.*, **129**, 318-321.
- Bonsdorff, W.**
(1904) *Z. anorg. Chem.*, **41**, 180.
- Boomer, E. H., Johnson, C. A., and Piercey, A. G. A.**
(1938) *Canadian J. Res.* (B), **16**, 396-410.
- Booth, H. S. and Starrs, B. A.**
(1931) *J. Phys. Chem.*, **35**, 3553-7.
- Booth, H. S., Starrs, B. A. and Bahnsen, M. J.**
(1933) *J. Phys. Chem.*, **37**, 1103-7.
- Bordeianu, C. V.**
(1933) *Arch. Pharm.*, **271**, 149-161.
- Botschwar.**
(1933) *Z. anorg. Chem.*, **210**, 163.
- Botta.**
(1911) *Zentralbl. Min. Geol.*, p. 123.
- Bottger, W.**
(1903) *Z. physik. Chem.*, **46**, 521-619.
(1906) *Z. physik. Chem.*, **56**, 83-94.
- Boubnoff, N. and Guye, Ph. A.**
(1911) *J. chim. phys.*, **9**, 304.
- Boulanger, Jeanne.**
(1936) *Compt. rend.*, **202**, 2156.
(1936a) *Compt. rend.*, **203**, 87-90.
- Boulouch, R.**
(1902) *Compt. rend.*, **135**, 165.
(1903) *Compt. rend.*, **136**, 1577.
(1906) *Compt. rend.*, **142**, 1045.
- Bourgoin.**
(1884) *Bull. Soc. chim.*, [2], **42**, 620.
- Bousfield, W. R.**
(1919) *J. Chem. Soc. (Lond.)*, **115**, 54.
- Boutaric, A.**
(1911) *Compt. rend.*, **153**, 876-7.
- Bovalini, E. and Fabris, E.**
(1933) *Gazz. chim. ital.*, **63**, 338-44.
(1935) *Gazz. chim. ital.*, **65**, 617-23.
- Bowen, N. L.**
(1914) *Am. Jour. Sci.* [4], **38**, 207-64.
(1926) *J. Phys. Chem.*, **30**, 726-37.
- Bowen, N. L. and Anderson, Olaf.**
(1914) *Am. Jour. Sci.* [4], **37**, 487.
- Bowman, A. A. and Hastings, A. B.**
(1937) *J. Biol. Chem.*, **119**, 241-6.
- Boye, Erich.**
(1933) *Z. anorg. Chem.*, **215**, 75-80.
(1934) *Z. anorg. Chem.*, **216**, 29-32.
- Boyer-Guillon, A.**
(1900) *Ann. conserv. Arts Metiers* [3], **2**, 187-211.

AUTHOR INDEX

- Boyle, Mary.
(1909) J. Chem. Soc. (Lond.), 95, 1696.
- Boyle, R. W.
(1911) Phil. Mag. [6], 22, 840-854.
- Bozorth, R. M.
(1923) J. Am. Chem. Soc., 45, 2653.
- Bozza, G.
(1934) Gior. chim. Ind. applicata, 16, 109-116.
- Bradley, W. P. and Alexander, W. B.
(1912) J. Am. Chem. Soc., 34, 17.
- Braley and Schneider.
(1921) J. Am. Chem. Soc., 43, 740.
- Brand, H.
(1911) Neues Jahrb. Min. Geol. (Beil. Bd.), 32, 627-700.
(1912) Zentralbl. Min. Geol. and Pal., 26-32.
(1913) Neues Jahrb. Min. Geol., 1, 9-27.
- Brandan.
(1869) Liebig's Ann., 151, 340.
- Braun, L.
(1900) Z. physik. Chem., 33, 732.
- Braune, H. and Strassmann, F.
(1929) Z. physik. Chem. (A), 143, 225-43.
- Braunschweig, M.
(1922) These-Zurich.
- Bray, Wm. C.
(1905-06) Z. physik. Chem., 54, 569-608.
- Bray, W. C. and Connolly, E. L.
(1910) J. Am. Chem. Soc., 32, 937.
(1911) J. Am. Chem. Soc., 33, 1485.
- Bray, W. C. and MacKay, G. M. T.
(1910) J. Am. Chem. Soc., 32, 914, 1207.
- Bray, Wm. C. and Winninghoff.
(1911) J. Am. Chem. Soc., 33, 1663.
- Breithaupt, J.
() These, Univ. of Geneva, 38, No. 446.
- Breuner, G.
(1920) These, Zurich.
(1926) "Tabellen Annuelles", 5, 922.
- Breitenbach, W. C.
(1925) Chem. Met. Eng., 32, 704.
- Briegleb.
(1856) Liebig's Ann., 97, 95.
- Briggs, T. R.
(1930) J. Phys. Chem., 34, 2260-6.
- Briggs, T. R. and Greenawald, J. A.
(1930) J. Phys. Chem., 34, 1951-60.
- Briggs, T. R. and Patterson, E. S.
(1932) J. Phys. Chem., 36, 2621-4.
- Briner, E. and Agathon.
(1926) Helv. chim. acta, 9, 905.
- Briner, E. and Perrottet, E.
(1939) Helv. chim. acta, 22, 397-404.
- Brinkley, S. R.
(1922) J. Am. Chem. Soc., 44, 1210-6.
- Brinton, Paul H. M. P.
(1916) J. Am. Chem. Soc., 38, 2365.
- Brintzinger, H. and Eckart, W.
(1937) Z. anorg. Chem., 231, 327-336.
- Briscoe, H. V. A., Evans C., and Robinson, P. L.
(1932) J. Chem. Soc. (Lond.), 1100-3.
- Briscoe, H. V. A. and Madgin, W. M.
(1923) J. Chem. Soc., 123, 1608-18.
- Brissemoret, M.
(1898) J. pharm. chim. [6], 7, 176-8.
- Britton, H. T. S.
(1921) J. Chem. Soc., 119, 1967-71.
(1922) J. Chem. Soc., 121, 982.
(1922a) J. Chem. Soc., 121, 2612-16.
(1923) J. Chem. Soc., 123, 1429-35.
(1924) J. Chem. Soc., 125, 1875.
(1925) J. Chem. Soc., 127, 2796-2807.
- Britton, H. T. S. and Allmand, A. J.
(1921) J. Chem. Soc., 119, 1463-70.
- Britton, H. T. S. and Jarrett, M. E. D.
(1936) J. Chem. Soc. (Lond.), 1489-1493.
(1936a) J. Chem. Soc. (Lond.), 1494-5.
- Britton, H. T. S. and McBain.
(1926) J. Am. Chem. Soc., 48, 593.
- Britton, H. T. S. and Robinson, R. A.
(1930) J. Chem. Soc. (Lond.), 2328-2343.
(1932) Trans. Faraday Soc., 28, 531-45.
- Broderson.
(1911) Masters Thesis Univ. of Kansas.
- Brodsky, A. E.
(1929) Z. Elektrochem., 35, 833-7.
- Brodsky, A. E. and Scherschewer, J. M.
(1926) Z. Elektrochem., 32, 1-4.

AUTHOR INDEX

Brönsted, J. N.

- (1906) Z. physik. Chem., **55**, 377.
- (1909) 7th Int. Congress Applied Chem., **10**, 110.
- (1911) Z. physik. Chem., **77**, 132.
- (1912) Z. physik. Chem., **80**, 208, 214.
- (1919) Medd. Vetenskapsakad. Nobel Inst., **5**, No. 25.
- (1919a) K. Danske-Videnska Selskal. Mat. fys. Medd., **2**, No. 10.
- (1920) J. Am. Chem. Soc., **42**, 761-86.
- (1920a) J. Am. Chem. Soc., **42**, 1448-54.
- (1921) K. Danske-Videnska Selskal. Mat. fys. Medd., **4**, No. 4.
- (1921a) Z. physik. Chem., **98**, 241.
- (1921) K. Danske-Videnska Selskal. Skr., **12**, 6.
- (1926) "Tabelleres Annueles", **5**, 922-3.
- (1922a) J. Am. Chem. Soc., **44**, 877, 938.
- (1922) Z. physik. Chem., **100**, 147.
- (1923) J. Am. Chem. Soc., **45**, 2898-2910.

Brönsted, J. N. and Brumbaugh, N. J.

- (1926) J. Am. Chem. Soc., **48**, 2015-20.

Brönsted, J. N. and Petersen, Agnes.

- (1921) J. Am. Chem. Soc., **43**, 2265-92.

Brönsted, J. N., Delbanco, A. and Volqvartz, K.

- (1932) Z. physik. Chem., **162**, 128-46.

Brönsted, J. N. and Volqvartz, K.

- (1928) Z. physik. Chem., **134**, 97-134.

de Brouckere, L. and Gillet, A.

- (1935) Bull. soc. chim. (Belg.), **44**, 473-503.

Broun, A. C.

- (1933) Zhurnal Obs. Khimii, **3**, 513-8, 998.

Brown, J. C.

- (1907) Proc. Chem. Soc., **23**, 233.
- (1907) J. Chem. Soc. (Lond.), **91**, 1826-31.

Brown, O. W.

- (1898) J. Phys. Chem., **2**, 51.

Browning and Hutchins.

- (1900) Z. anorg. Chem., **22**, 380.

Brüll, W. and Ellerbrock, W.

- (1934) Z. anorg. Chem., **216**, 353.

Bruner, L.

- (1898) Z. physik. Chem., **26**, 147.

Bruner, L. and Zawadski, J., et. al.

- (1909) Bull. Internat. acad. Sci. Cracovie, **3**, 9, A, 267-312, 377.
- (1909) Z. anorg. Chem., **65**, 136.
- (1910) Z. anorg. Chem., **67**, 454-5.
- (1910) Chem. Abs., **4**, 980, 2758.

Bruni, G. and Finzi, F.

- (1905) Gazz. chim. ital., **35**, 11, 111-31

Bruni, G. and Meneghini.

- (1909) Z. anorg. Chem., **64**, 193.
- (1910) Gazz. chim. ital., **40**, 1, 682.

Bruni, G. and Pelizzola, C.

- (1921) Atti. accad. Lincei, **30**, 159.

Bruylauts and Mund.

- (1919) Bull. acad. Belg., 113.

de Bruyn, C. A. Lobry.

- (1890) Rec. trav. chim., **9**, 188.
- (1892) Z. physik. Chem., **10**, 782-789.
- (1892) Rec. trav. chim., **11**, 29, 112-56.
- (1894) Rec. trav. chim., **13**, 116, 150.
- (1899) Rec. trav. chim., **18**, 87.
- (1900) Z. physik. Chem., **32**, 63, 85, 92, 101.
- (1903) Rec. trav. chim., **22**, 411.

Bube, Kurt.

- (1910) Z. anal. Chem., **45**, 525-96.

Buch, Kurt.

- (1925) Soc. Sci. Fennica. Comm., Phys. Math., **2**, No. 16, 1-9.

Buchanan, G. H. and Winner, G. B.

- (1920) Ind. Eng. Chem., **12**, 448-51.

Büchner, E. H.

- (1865) Sitzber. k. Akad. Wiss. (Wein), **52**, 2, 644.
- (1905-06) Z. physik. Chem., **54**, 665-88.

Büchner, E. H. and Karsten, B. J.

- (1908-9) Proc. k. Akad. Wet. (Amst.), **11**, 504.

Büchner, E. H. and Prins, Ada.

- (1912-13) Z. phys. Chem., **81**, 113-20.

Buckley, P. and Hartley, H.

- (1929) Phil. Mag., **8**, 320.

Budnikoff, P. P. and Syркин, J. K.

- (1922) Z. anorg. allgem. Chem., **125**, 263.

Buell, H. D. and McCrosky, C. R.

- (1921) J. Am. Chem. Soc., **43**, 2031.

AUTHOR INDEX

- Bump, C. K.**
(1932) *J. Phys. Chem.*, **36**, 1851-2.
- Bunsen, Robert.**
(1877) "Gasometrische Methoden,"
2nd Ed.
- Bunsen-Heurich.**
(1892) *Z. physik. Chem.*, **9**, 438.
- Bureau, Jean**
(1934) *Compt. rend.*, **198**, 1918-20.
(1935) *Compt. rend.*, **201**, 67, 1193.
(1935a) *Compt. rend.*, **200**, 395.
(1936) *Compt. rend.*, **203**, 999.
(1937) *Ann. chim.*, **11**, 8, 97-142.
- Burgess, S. G. and Hunter, H.**
(1929) *J. Chem. Soc. (Lond.)*, 2838-52.
- Burkhardt, G. N. and Lapworth, A.**
(1926) *J. Chem. Soc.*, **129**, 684-90.
- Burrage, L. J.**
(1926) *J. Chem. Soc.*, **129**, 1703-9, 1896.
(1932) *Trans. Faraday Soc.*, **28**, 529-31.
- Bury, Chas. R.**
(1924) *J. Chem. Soc.*, **125**, 2538-41.
- Bury, C. R. and Davies, E. R. H.**
(1932) *J. Chem. Soc. (Lond.)*, 2008-15.
(1933) *J. Chem. Soc. (Lond.)*, 701-5.
- Bury, C. R. and Mends, J. R.**
(1939) *J. Chem. Soc. (Lond.)*, 742-4.
- Bury, C. R. and Owens, R. D. J.**
(1935) *Trans. Faraday Soc.*, **31**, 480-2.
(1936) *Trans. Faraday Soc.*, **32**, 782-7.
- Bury, C. R. and Redd, R.**
(1933) *J. Chem. Soc.*, 1160-2
- Busch, Werner.**
(1927) *Z. anorg. Chem.*, **161**, 161-79.
- Butler, J. A. V. and Hiscocks, E. S.**
(1926) *J. Chem. Soc.*, **129**, 2554-62.
- Butler, K. H. and Maass, O.**
(1930) *J. Am. Chem. Soc.*, **52**, 2188.
- Büttgenbach, E.**
(1925) *Z. anorg. allgem. Chem.*, **145**,
141-50.
- Cabot, G. L.**
(1897) *J. Soc. Chem. Ind.*, **16**, 417.
- Cadenhead, A. F. G. and Vining, W. H.**
(1924) *Canadian Chem. Met.*, **8**, 64-5.
- Cady, G. H.**
(1934) *J. Am. Chem. Soc.*, **56**, 1431-4.
- Cady, G. H. and Hildebrand, J. H.**
(1930) *J. Am. Chem. Soc.*, **52**, 3843-6.
- Cady, H. P., Elsey, H. M. and Berger, E. V.**
(1922) *J. Am. Chem. Soc.*, **44**, 1456-16.
- Cady, H. P. and Jones, E. A.**
(1933) *J. Phys. Chem.*, **37**, 303-20.
- Cagle, W. C., Tarbutton, G. and Vosburgh, W. C.**
(1934) *J. Am. Chem. Soc.*, **56**, 2331.
- Cagle, W. C. and Vosburgh, W. C.**
(1935) *J. Am. Chem. Soc.*, **57**, 414.
- Caglioti, V. and Malossi, L.**
(1929) *Atti accad. Lincei*, **[6]**, **10**, 97-100.
- Caglioti, V. and Stolfi, A.**
(1927) *Atti accad. Lincei*, **[6]**, **5**, 896-901.
- Caillart, M.**
(1918) *Bull. soc. franç. min.*, **41**, 21-30.
- Calcagni, G.**
(1912) *Gazz. chim. ital.*, **42**, **11**, 653, 661.
(1912a) *Atti accad. Lincei*, **[5]**, **21**, **11**, 72.
(1920) *Gazz. chim. ital.*, **50**, **11**, 331-40.
(1923) *Gazz. chim. ital.*, **53**, 114-19.
- Calcagni, G. and Mancini, G.**
(1910) *Atti accad. Lincei*, **[5]**, **19**, **11**, 424.
- Calcagni, G. and Marotta, D.**
(1912) *Gazz. chim. ital.*, **42**, **11**, 669-80.
(1912) *Atti accad. Lincei*, **[5]**, **21**, **11**, 93,
243, 284.
(1913) *Gazz. chim. ital.*, **43**, **11**, 380.
(1913) *Atti accad. Lincei*, **[5]**, **22**, **11**,
373, 443.
(1914) *Gazz. chim. ital.*, **44**, **1**, 487.
- Callender and Barnes.**
(1897) *Proc. Roy. Soc.*, **62**, 149.
- Calvert, H. T.**
(1901) *Z. physik. Chem.*, **38**, 521-540.
- Calzolari, F.**
(1912) *Gazz. chim. ital.*, **42**, **11**, 85-92.
() *Acc. sc. med. e. nat. di Ferora*,
85, 150.
- Cambi, L.**
(1912) *Atti accad. Lincei*, **[5]**, **21**, **1**,
776, 791.
(1912) *Atti accad. Lincei*, **[5]**, **21**, **11**, 839.
(1912) *Atti Inst. Lombardo*, **45**, **11**, 182.
- Cambi, L. and Bozza, G.**
(1923) *Ann. chim. applicata*, **13**, 221-38.
- Cambi, L. and Speroni, G.**
(1915) *Atti accad. Lincei*, **[5]**, **24**, **1**, 736.

AUTHOR INDEX

- Cameron, F. K.
 (1898) J. Phys. Chem., 2, 413.
 (1901) J. Phys. Chem., 5, 556.
 (1930) J. Phys. Chem., 34, 692-710.
 (1936) J. Phys. Chem., 40, 689-96.
- Cameron, F. K. and Bell, J. M.
 (1905) J. Am. Chem. Soc., 27, 1512.
 (1906) J. Am. Chem. Soc., 28, 1220, 1222.
 (1906a) J. Phys. Chem., 10, 210.
 (1907) J. Phys. Chem., 11, 363.
 (1910) J. Am. Chem. Soc., 32, 869.
- Cameron, F. K., Bell, J. M., and Robinson, W. O.
 (1907) J. Phys. Chem., 11, 396-420.
- Cameron, F. K. and Breazeale, J. F.
 (1903) J. Phys. Chem., 7, 574.
 (1904) J. Phys. Chem., 8, 335.
- Cameron, F. K. and Brown,
 (1905) J. Phys. Chem., 9, 210.
- Cameron, F. K. and Crockford, H. D.
 (1929) J. Phys. Chem., 33, 709-16.
- Cameron, F. K. and Patten, H. E.
 (1911) J. Phys. Chem., 15, 67.
- Cameron, F. K. and Robinson, W. O.
 (1907) J. Phys. Chem., 11, 577, 641, 691.
 (1907a) J. Phys. Chem., 11, 273-8.
 (1909) J. Phys. Chem., 13, 157, 251.
- Cameron, F. K. and Seidell, A.
 (1901) Bull. No. 18, Division of Soils,
 U.S. Dept. Agr.
 (1901a) J. Phys. Chem., 5, 643.
 (1902) J. Phys. Chem., 6, 50.
 (1904) J. Am. Chem. Soc., 26, 1460.
 (1905) J. Am. Chem. Soc., 27, 1508.
- Campardou, J.
 (1933) Bull. Soc. chim. (France) [4],
 53, 1400-4.
- Campbell, A. N. and Campbell, A. J. R.
 (1932) J. Am. Chem. Soc., 54, 3834-41.
- Campbell, A. N., Downs, K. W. and Samis, C. S.
 (1934) J. Am. Chem. Soc., 56, 2507-12.
- Campbell, A. N. and Slotin, L.
 (1933) J. Am. Chem. Soc., 55, 3961-70.
- Campbell, A. N. and Yanick, N. S.
 (1932) Trans. Faraday Soc., 28, 657-60.
- Canneri, G.
 (1928) Gazz. chim. ital., 58, 6-25.
- Canneri, G. and Bigalli, D.
 (1936) Ann. chim. applicata, 26, 430-6.
- Canneri, G. and Fernandez, L.
 (1925) Atti accad. Lincei, 6, 1, 671-6.
- Canneri, G. and Morelli, R.
 (1922) Atti accad. Lincei, 5, 31, 1,
 109-11.
- Cantoni, H. and Basadonna.
 (1906) Bull. soc. chim., 3, 35, 731.
- Cantoni, H. and Diotallevi, D.
 (1905) Bull. soc. chim., 3, 33, 27-36.
- Cantoni, H. and Goguelia, G.
 (1905) Bull. soc. chim., 3, 33, 13.
- Cantoni, H. and Jolkowsky.
 (1907) Bull. soc. chim., 4, 1, 1181.
- Cantoni, H. and Passamanik.
 (1905) Ann. chim. anal. appl., 10, 258.
- Cantoni, H. and Zachoder.
 (1905) Bull. soc. chim., [3], 33, 747.
- Carlson, Birger,
 (1910) Klason-Festschrift, 247-66
 (Stockholm).
 (1910) "Tables annuelles," 1, 379.
- Carnelly.
 (1873) Liebig's Ann., 166, (116?), 155.
 (1873) J. Chem. Soc. (Lond.), 2, 11, 323.
- Carnelly and Thomson.
 (1888) J. Chem. Soc. (Lond.), 53, 799.
- Caro.
 (1874) Arch. Pharm., 3, 4, 145.
- Carobbi, G.
 (1924) Atti accad. Lincei, 5, 33, 11,
 416-20.
 (1926) Gazz. chim. ital., 56, 76-81.
 (1928) Gazz. chim. ital., 58, 45.
- Carpenter.
 (1886) J. Soc. Chem. Ind., 5, 286.
- Carpenter, C. and Lehrman, A.
 (1925) Trans. Am. Inst. Chem. Eng., 17, 35.
- Carpenter, C. B. and Hayward, C. R.
 (1923) Eng. Min. J. Press, 115, 1055-61.
- Carpenter, D. C. and Kucera, J. J.
 (1934) J. Am. Chem. Soc., 56, 324-7.
- Carpenter, D. C. and Mack, G. L.
 (1934) J. Am. Chem. Soc., 56, 311-3.

AUTHOR INDEX

- Carrara and Minozzi.**
(1897) Gazz. chim. ital., 27, 11, 955.
- Carter, J. S.**
(1925) J. Chem. Soc., 127, 2861-66.
(1928) J. Chem. Soc. (Lond.), 2227-30.
- Carter, J. S. and Hoskins, C. R.**
(1929) J. Chem. Soc. (Lond.), 580-5.
- Carter, R. H.**
(1928) Ind. Eng. Chem., 20, 1195.
(1930) Ind. Eng. Chem., 22, 886-9.
- Carter, S. R. and Hartshorne, N. H.**
(1923) J. Chem. Soc., 123, 2223-33.
(1926) J. Chem. Soc., 129, 363-74.
- Carter, S. R. and Megson, N. J. L.**
(1928) J. Chem. Soc., (Lond.), 131, 2954-67.
- Carveth, H. R.**
(1898) J. Phys. Chem., 2, 213.
- Caspari, W. A.**
(1924) J. Chem. Soc., 125, 2381-7.
- Casparis, P.**
(1919) Schweiz. Apoth. Ztg., 57, 255.
- Cassuto, L.**
(1913) Nuovo cimento, 6, 1903.
- Cauquil, Germaine.**
(1927) J. chim. phys., 24, 53-5.
- Causse.**
(1892) Compt. rend., 114, 414.
- Cavanagh, B.**
(1924) Proc. Roy. Soc. (Lond.), Ser. A, 106, 243-250.
- Cavazzi, A.**
(1916) Gazz. chim. ital., 46, 11, 122-35.
(1917) Gazz. chim. ital., 47, 11, 49-63.
- Caven, R. M.**
(1932) J. Chem. Soc. (Lond.), 2417-20.
- Caven, R. M. and Johnston, W.**
(1926) J. Chem. Soc., 129, 2628-32.
(1927) J. Chem. Soc., 130, 2358, 2902.
(1928) J. Chem. Soc., 131, 2506.
- Caven, R. M. and Mitchell, T. C.**
(1924) J. Chem. Soc., 125, 1428-31.
(1925) J. Chem. Soc., 127, 527-31.
(1925a) J. Chem. Soc., 127, 2549-51.
- Centnerszwer, M.**
(1910) Z. physik. chem., 72, 437.
- de Cesari, P.**
(1911) Atti accad. Lincei, 151, 20, 1, 597, 749.
- Chadwell, H. M.**
(1927) J. Am. Chem. Soc., 49, 2795-2801.
- Chamberlain, N. H., Hume, J. and Topley, B.**
(1926) J. Chem. Soc., 129, 2620-23.
- Chambon, M., Bouvier, J. and Duron, L.**
(1937) Bull. soc. chim., [5], 4, 1401-7.
- Chambon, M. and Duron, P.**
(1937) Bull. soc. chim., [5], 4, 1407-10.
- Chancel and Parmentier.**
(1885) Compt. rend., 100, 473, 773.
(1887) Compt. rend., 104, 474.
- Chandler, E. E.**
(1908) J. Am. Chem. Soc., 30, 696.
- Chaney, A. L. and Mann, C. A.**
(1931) J. Phys. Chem., 35, 2289-2314.
- Chassenent, L.**
(1926) Ann. chim. [10], 6, 272, 313-51.
- Chatlet, M.**
(1934) Ann. chim. [11], 2, 5-25.
- Chikashigi, M. and Yamanchi, Y.**
(1916) Mem. Coll. Sci. Kyoto, 1, 341-7.
- Chilesotti, A.**
(1908) Atti accad. Lincei, [5], 17, 11, 475.
- Chlopin, W.**
(1925) Z. anorg. allgem. Chem., 143, 108.
- Chlopin, W. and Nikitin, B.**
(1927) Z. anorg. Chem., 166, 311-35.
- Chlopin, W., and Polessitsky, A.**
(1928) Z. anorg. Chem., 172, 310-20.
- Chlopin, W., Pollessitsky, A. and Tolmatscheff, P.**
(1929) Z. physik. Chem., (A), 145, 57.
- Chloupek, J. B. and Danes, V. Z.**
(1932) Coll. Czechoslovak. Chem. Com., 4, 8-19.
- Chloupek, J. B., Danes, V. Z. and Danesova, B. A.**
(1932) Chem. Listy, 26, 531.
(1932) Coll. Czechoslovak. Chem. Com., 4, 473-9.
(1933) Coll. Czechoslovak. Chem. Com., 5, 339-42.
- Chrétien, Andre.**
(1926) Caliche, 7, 439, 8, 355, 390.
(1927) Caliche, 9, 248.
(1929) These, Paris.
(1930) Ann. chim. [10], 6, 272, 313-51.

AUTHOR INDEX

- Chretien, A. and Hoffer, O.**
(1935) *Compt. rend.*, **201**, 1131-3.
- Chretien, A. and Varga, G.**
(1935) *Compt. rend.*, **201**, 1491-3.
- Chretien, A. and Weil, R.**
(1935) *Bull. Soc. Chim.* [5], **2**, 1577-91.
- Christensen.**
(1885) *J. prakt. Chem.*, [2], **31**, 166.
- Christoff, A.**
(1905) *Z. physik. Chem.*, **53**, 321.
(1906) *Z. physik. Chem.*, **55**, 627.
(1912) *Z. physik. Chem.*, **79**, 459.
- Christy, S. B.**
(1901) *Elektrochem. Ztschr.*, **7**, 205.
- Chugaev, L. and Khlopin, W.**
(1914) *Z. anorg. Chem.*, **86**, 159.
- Cingolani, M.**
(1908) *Gazz. chim. ital.*, **38**, 1, 305.
(1908) *Atti accad. Lincei*, [5], **17**, 1, 265.
- Cirikov, F. V.**
(1918) *J. Agriculture experimental*
(Petrograd), **19**, 173.
- Claassen, H.**
(1911) *Z. Ver. Zuckerind.*, **61**, 489-509.
- Clark, G. L.**
(1919) *J. Am. Chem. Soc.*, **41**, 1477-91.
- Clark, L. M. and Hunter, H.**
(1935) *J. Chem. Soc. (Lond.)*, 383-91.
- Clark, N. A.**
(1931) *J. Phys. Chem.*, **35**, 1232-8.
- Clayton, W. J. and Vosburgh, W. C.**
(1937) *J. Am. Chem. Soc.*, **56**, 2414-21.
- Clendinnen, F. W. J.**
(1922) *J. Chem. Soc.*, **121**, 801-5.
(1923) *J. Chem. Soc.*, **123**, 1338-44.
- Clendinnen, F. W. J. and Rivett, A. C. D.**
(1921) *J. Chem. Soc.*, **119**, 1329-39.
(1923) *J. Chem. Soc.*, **123**, 1344-51.
- Cleve.**
(1866?) *K. Svenska Vetenskaps-Akad. Handl. (Stockholm)*,
10, 9, 7.
(1874) *Bull. soc. chim.*, [2], **21**, 344.
(1885) *Bull. soc. chim.*, [2], **43**, 166.
- Cleve, Astrid,**
(1902) *Z. anorg. Chem.*, **32**, 157.
- Clifford, A. T. and Cameron, F. K.**
(1929) *Ind. Eng. Chem.*, **29**, 69.
- Clifford, Chas. W.**
(1921) *Ind. Eng. Chem.*, **13**, 628-32.
- Clifford, I. L. and Hunter, E.**
(1933) *J. Phys. Chem.*, **37**, 101-118.
- Cloez.**
(1903) *Bull. soc. chim.* [3], **29**, 167.
- Clowes, F. and Biggs, J. W. H.**
(1904) *J. Soc. Chem. Ind.*, **23**, 358.
- Coates, J. E. and Hartshorne, N. H.**
(1931) *J. Chem. Soc. (Lond.)*, 657-665.
- Cocheret, D. H.**
(1911) *Dissertation*, Leiden.
(1911) *"Tables Annuelles"* **2**, 439, 444.
- Cohen, Ernst.**
(1900) *Z. physik. Chem.*, **34**, 189, 622.
(1903) *Z. Elektrochem.*, **9**, 433.
(1909) *Z. Elektrochem.*, **15**, 600.
- Cohen, Ernst and Bredée, H. L.**
(1925) *Z. physik. Chem.*, **117**, 143-55.
(1925) *Proc. Acad. Sci. Amsterdam*,
28, 573-586.
- Cohen, E., Hettterschij, B. W. G. and Moesveld, A. L. Th.**
(1920) *Z. physik. Chem.*, **94**, 224.
(1925) *Z. physik. Chem.*, **115**, 440-3.
- Cohen, E. and Inouye, K.**
(1910) *Z. physik. Chem.*, **72**, 411-24.
(1910) *Chem. Weekblad.*, **7**, 277.
- Cohen, E. Inouye, K. and Euwen, C.**
(1910) *Z. physik. Chem.*, **75**, 257.
- Cohen, E., de Meester, W. A. T. and Moesveld, A. L. Th.**
(1924) *Z. physik. Chem.*, **112**, 150-5.
- Cohen, E. and Miyake.**
(1925) *Proc. Acad. Sci. Amst.*, **28**,
936-41.
- Cohen, E. and Moesveld, A. L. Th.**
(1925) *Proc. Acad. Sci. (Amsterdam)*,
28, 461-6.
(1925) *Verslag. Akad. Wetenschappen*
(Amsterdam), **34**, 143-9.
- Cohen, E. and Sinnige, L. R.**
(1910) *Trans. Faraday Soc.*, **5**, 269.
- Cohen, Ernst and Van der Bosch, J. C.**
(1925) *Z. physik. Chem.*, **114**, 453-484.

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- Cohen, E., Voller, D. H. P. and Moesveld, A. L. Th.
(1923) Z. physik. Chem., [104], 323-33.
- Cohen, E. and Wolters, J. J.
(1920) Z. physik. Chem., 96, 256.
(1917) Verslag. Akad. Wetenschappen (Amsterdam), 26, 797.
- Cohn, E.
(1895) Z. physik. Chem., 18, 61.
- Colani, A.
(1913) Compt. rend., 156, 1075, 1908.
(1916) Bull. soc. chim., [4], 19, 405.
(1916a) Compt. rend., 163, 123-5.
(1917) Compt. rend., 165, 111-3, 234-6.
(1925) Bull. soc. chim., [4], 37, 856-61.
(1926) Bull. soc. chim., 39, 1243-5.
(1927) Compt. rend., 185, 1475-6.
(1928) Bull. soc. chim. [4], 43, 194-9, 754-62.
(1934) Compt. rend., 198, 1510-12.
(1934) Bull. soc. chim. [5], 1, 1376-9.
- Cole, H. I.
(1932) Philippine J. Sci., 47, 351-5.
- Collins, S. C. and Cameron, F. K.
(1928) J. Phys. Chem., 32, 1705-16.
- Colson, A.
(1907) Compt. rend., 145, 1167.
- de Coninck, Oechsner.
(1900) Compt. rend., 130, 1304; 131, 59, 1219.
(1901) Bull. acad. roy. (Belgique), 350.
(1903) Ann. chim. phys., [7], 28, 7.
(1905) Chem. Centralbl., 76, 11, 883.
(1905) Bull. acad. roy. (Belgique), pp. 257, 359.
(1906) Compt. rend., 142, 571.
- Conrad, F. H. and Beuschlein, W. L.
(1934) J. Am. Chem. Soc. 56, 2554-62
- Conroy.
(1898) J. Soc. Chem. Ind., 17, 104.
- Cooke, W. T.
(1921) J. Soc. Chem. Ind., 40, 56, 239.
- Cooper, E. A. and Nicholas, S. D.
(1925) Biochem., J. 19, 533-7.
- Cooper, H. C., Shaw, R. I., and Loomis, N. E.
(1909) Am. Chem. Jour., 42, 461.
(1909) Ber., 42, 3991.
- Copisarow, M.
(1915) Chem. News., 112, 247.
- Coppadoro, A.
(1909) Gazz. chim. ital., 39, 11, 625.
(1911) Rend. soc. chim. ital., [2], 3a, 207.
(1912) Gazz. chim. ital., 42, 1, 240.
(1912) Atti accad. Lincei, [5], 21, 11, 842.
(1913) Gazz. chim. ital., 43, 1, 138.
- de Coppet, L. C.
(1872) Ann. chim. phys., [4], 25, 528.532.
(1883) Ann. chim. phys., [5], 30, 417.
(1899) Ann. chim. phys., [7], 16, 275.
- Corbet, A. S.
(1926) J. Chem. Soc., 129, 3190-3202.
- Cornec, E. and Chretien, A.
(1924) Caliche, 6, 358-69.
- Cornec, E. and Urbain, G.
(1919) Bull. soc. chim., [4], 25, 215-22.
- Cornec, E. and Dickeley, J.
(1926) Caliche, 8, 99.
(1927) Compt. rend., 184, 1555-7.
(1927) Bull. soc. chim., 41, 1017-27
- Cornec, E. and Hering, H.
(1925-6) Revista Caliche, 7, 299.
(1926-7) Revista Caliche, 8, 51.
- Cornec, E. and Krombach, H.
(1928) Caliche, 10, 59.
(1929) Ann. chim., [10], 12, 203-295.
(1932) Compt. rend., 194, 714-6.
(1932) Ann. chim., [10], 18, 5-31.
- Corneck, E., Krombach, H. and Spack, A.
(1930) Ann. chim., [10], 13, 526-623.
- Cornec, E. and Neumeister, A.
(1929) Revista Caliche (Chile), 10, 492-9.
- Cornec, E. and Spack, A.
(1931) Bull. soc. chim. (France), [4], 49, 582-94.
- Cossa, A.
(1868) Ber., 1, 138.
(1869) Z. anal. Chem., 8, 145.
- Costachescu, N.
(1910) Ann. Sci. Univ. (Jassy), 7, 1.
- Coste, J. H.
(1917) J. Soc. Chem. Ind., 36, 846-53.
(1918) J. Soc. Chem. Ind., 37, 170.
(1927) J. Phys. Chem., 31, 81-7.
- Coste, J. H. and Andrews, E. R.
(1924) J. Phys. Chem., 28, 285-6.

AUTHOR INDEX

- Cottrell, et al.**
(1901) Sitzber. k. Akad. Wiss. (Berlin),
p. 1035.
- Couch, J. F.**
(1917) Am. Jour. Pharm., 89, 243-51.
- Courtois,**
(1914) Compt. rend., 158, 1511.
- Cox, G. J., Dodds, M. L. and Clasper, C.**
(1934) J. Am. Pharm. Assoc., 23, 662-4.
- Craig, D. N., Vinal, G. W. and Vinal, F. E.**
(1936) J. Research U.S. Bureau Stand.,
17, 709-720.
- Cranston, J. A. and Livingstone, A. Y.**
(1926) J. Chem. Soc., 129, 501-3.
- Craven, R. M. and Bryce, G.**
(1934) J. Chem. Soc. (Lond.), 514-7.
- Craven, R. M. and Gardner, W. K.**
(1933) J. Chem. Soc. (Lond.), 943-6.
- Creighton, H. J. M., and Ward, W. H.**
(1915) J. Am. Chem. Soc., 37, 2333.
- Cremer, H. W. and Duncan, D. R.**
(1931) J. Chem. Soc. (Lond.), 2243-54.
- Crew, M. C. and Steine, H. E. and Hopkins, B. S.**
(1925) J. Phys. Chem., 29, 34-8.
- Crockford, H. D. and Addlestone, J. A.**
(1936) J. Phys. Chem., 40, 303-5.
- Crockford, H. D. and Brawley, D. J.**
(1932) J. Phys. Chem., 36, 1594.
(1934) J. Am. Chem. Soc., 56, 2600-1.
- Crockford, H. D. and Warrick, L. E.**
(1930) J. Phys. Chem., 34, 1064-70.
- Crockford, H. D. and Webster, M. M.**
(1930) J. Phys. Chem., 34, 2375.
- Croft.**
(1842) Phil. Mag., [3], 21, 356.
- Crommelin, C. A., Martinez, J. P. and
Kamerlingh-Onnes, H.**
(1919) Verslag. Akad. Wetenschappen
(Amsterdam), 27, 1316-26.
(1920) Proc. Acad. Sci. Amsterdam,
22, 108-118.
- Crookes, Wm.**
(1864) J. Chem. Soc. (Lond.), 2, 134.
- Crowell, R. D.**
(1918) J. Am. Chem. Soc., 40, 455.
- Cuno, E.**
(1908) Ann. physik., [4], 25, 346-76.
(1908-09) Ann. physik., [4], 28, 663-4.
- Cupples, H. L.**
(1929) J. Am. Chem. Soc., 51, 1026-33.
- Cupr, Vaclav.**
(1925) Rec. trav. chim., 44, 478.
(1925a) Pub. fac. Sci. Univ. Masaryk. 63.
(1926) Pub. fac. Sci. Univ. Masaryk. 68, 8.
(1928) Rec. trav. chim., 47, 55.
(1929) Z. anal. Chem., 76, 177.
- Curry, James and Hazelton, C. L.**
(1938) J. Am. Chem. Soc., 60, 2771-3.
- Curtis, H. A. and Titus, E. Y.**
(1915) J. Phys. Chem., 19, 740.
- Curtius, Th. and Rissom, J.**
(1898) J. prakt. Chem., (2), 58, 277-87.
- Cuttica, V.**
(1920) Atti accad. Lincei., 5, 29, 11,
89-92.
- Cuvelier, B. V. J.**
(1933) Natuur wetensch. Tijdschr., 15, 177.
(1935) Z. anal. chem., 102, 16-19.
(1936) Z. anorg. Chem., 226, 197-200.
- Dalton, R. H., Pomeroy, R. and Weymouth, L. E.**
(1924) J. Am. Chem. Soc., 46, 60-4.
- Damiens, A.**
(1920) Compt. rend., 171, 1140.
(1921) Bull. soc. chim., [4], 29, 512, 696.
(1921a) Bull. soc. chim., [4], 29, 976-87
1063-70.
(1921) Compt. rend., 172, 448, 1105; 173,
300, 583.
(1923) Ann. chim., [9], 19, 44-119.
- van Damm, W. and Donk, A. D.**
(1911) Chem. Weekblad, 8, 848.
- Dancaster, E. A.**
(1932) J. Phys. Chem., 36, 1712-32.
- Danneel, H. and Fröhlich, K. W.**
(1930) Z. anorg. Chem., 188, 14-31.
- Dancer.**
(1862) J. Chem. Soc. (Lond.), 15, 477.
- D'Ans, J.**
(1908) Ber., 41, 1776-7.
(1909) Z. anorg. Chem., 62, 129-167.
(1909a) Z. anorg. Chem., 63, 225-9.
(1909b) Z. anorg. Chem., 65, 228.
(1909c) Z. anorg. Chem., 61, 91-5.
(1913) Z. anorg. Chem., 80, 235.
(1915) Z. anorg. Chem., 81, 177.

AUTHOR INDEX

- D'Ans, J. and Busch, F.**
(1937) *Z. anorg. Chem.*, **232**, 359-68.
- D'Ans, J. and Dawihl, W.**
(1929) *Z. anorg. Chem.*, **178**, 252-6.
- D'Ans, J. and Fritzsche, O.**
(1909) *Z. anorg. Chem.*, **65**, 231.
- D'Ans, J. and Hofer, P.**
(1934) *Z. angew. Chem.*, **47**, 71.
(1937) *Angewandte Chem.*, **50**, 101-4.
- D'Ans, J. and Schreiner, O.**
(1910) *Z. anorg. Chem.*, **67**, 437.
(1910a) *Z. physik. Chem.*, **75**, 95-107.
- D'Ans, J., Shepherd, L. D'Arcy and Gunther, P.**
(1905) *Z. anorg. Chem.*, **49**, 356-61.
- D'Ans, J. and Siegler, R.**
(1913) *Z. physik. Chem.*, **82**, 35-44.
- d'Anselme.**
(1903) *Bull. soc. chim.*, **[33]**, 29, 372.
- Dave, P. C. and Krishnaswami, K. R.**
(1933) *J. Indian Inst. Sci. (A)*, **16**, 153.
- Davidsohn, J. and Wrage, W.**
(1915) *Chem. Rev. Fett. Harz. Ind.*, **22**, 9-14.
- Davidson, A. W. and Chappell, W.**
(1933) *J. Am. Chem. Soc.*, **55**, 3531-7, 4524-5.
(1938) *J. Am. Chem. Soc.*, **60**, 2043-6.
(1939) *J. Am. Chem. Soc.*, **61**, 2164-7.
- Davidson, A. W. and Geer, H. A.**
(1933) *J. Am. Chem. Soc.*, **55**, 642-9.
(1938) *J. Am. Chem. Soc.*, **60**, 1211-4.
- Davidson, A. W. and Griswold, E.**
(1931) *J. Am. Chem. Soc.*, **53**, 1341-9.
(1935) *J. Am. Chem. Soc.*, **57**, 423-7.
- Davidson, A. W. and Holm, V.**
(1931) *J. Am. Chem. Soc.*, **53**, 1350-7.
- Davidson, A. W. and McAllister, W. H.**
(1930) *J. Am. Chem. Soc.*, **52**, 507-526.
- Davies, C. W.**
(1938) *J. Chem. Soc. (Lond.)* 277-81.
- Davies, C. W. and Robinson, R. A.**
(1937) *Trans. Faraday Soc.*, **33**, 633-5.
- Davis, H. S.**
(1916) *J. Am. Chem. Soc.*, **38**, 1169.
- Davis, R. O. E. and Black, C. A.**
(1931) *Ind. Eng. Chem.*, **23**, 1280-2.
- Davis, T. W. and Ricci, J. E.**
(1939) *J. Am. Chem. Soc.*, **61**, 746-8.
- Dawkins, A. E.**
(1922) *J. Chem. Soc.*, **[21]**, 776-81.
- Dawkins, A. E. and Weldon, P. R.**
(1922) *Proc. Soc. Chem. Ind. (Victoria)*, **22**, 940-8.
(1925) *Chem. Abs.*, **19**, 1079.
- Dawson, H. M.**
(1901) *J. Chem. Soc. (Lond.)*, **79**, 242.
(1902) *J. Chem. Soc. (Lond.)*, **81**, 1086-1097.
(1904) *J. Chem. Soc. (Lond.)*, **85**, 467.
(1905) *J. Chem. Soc. (Lond.)*, **89**, 1668.
(1908) *J. Chem. Soc. (Lond.)*, **93**, 1310.
(1909) *Z. physik. Chem.*, **69**, 110-22.
(1909a) *J. Chem. Soc. (Lond.)*, **95**, 370-81.
(1909b) *J. Chem. Soc. (Lond.)*, **95**, 874.
(1918) *J. Chem. Soc.*, **[13]**, 675-86.
- Dawson, H. M. and Gawler, R.**
(1902) *J. Chem. Soc. (Lond.)*, **81**, 524.
- Dawson, H. M. and Goodson, E. E.**
(1904) *J. Chem. Soc. (Lond.)*, **85**, 796.
- Dawson, H. M. and McCrae, J.**
(1900) *J. Chem. Soc. (Lond.)*, **77**, 1239-62.
(1901a) *J. Chem. Soc. (Lond.)*, **79**, 493.
(1901b) *J. Chem. Soc. (Lond.)*, **79**, 1069.
- Deacon, G. E. R.**
(1927) *J. Chem. Soc. (Lond.)*, **130**, 2063-5.
- DeCarli, F.**
(1931) *Ann. chim. applicata*, **21**, 447-53.
(1932) *Atti accad. Lincei* **[6]**, **15**, 579-583, 747-52.
(1932a) *Atti accad. Lincei*, **[6]**, **15**, 584-90.
- Dede, L. and Walther, Th.**
(1927) *Z. anorg. Chem.*, **163**, 185-194.
- Dehn, Wm. M.**
(1917) *J. Am. Chem. Soc.*, **39**, 1400.
(1917a) *J. Am. Chem. Soc.*, **39**, 1378.
- De Jong (see de Jong).**
- Delange, Leon.**
(1908) *Bull. soc. chim.*, **[4]**, 3, 910-5.
- Delaplace, R.**
(1922) *J. pharm. chim.*, **[7]**, 26, 139.

AUTHOR INDEX

- Delepine, M.**
 (1892) J. pharm. chim., [5], 25, 496.
 (1895) Bull. soc. chim., [3], 13, 353.
 (1908) Bull. soc. chim., [4], 3, 904.
- Delepine, M. and Arquet, M.**
 (1928) Bull. soc. pharmacol., 35, 625.
- Delwaulle, Marie Louise.**
 (1934) Compt. rend., 199, 948.
 (1935) Compt. rend., 201, 341.
 (1936) Bull. soc. chim. [5], 3, 1820-2.
- Delyon, M. L.**
 (1936) Bull. Soc. Chim. [5], 3, 1632-8, 1811-7.
- Demarcay.**
 (1883) Compt. rend., 96, 1860.
- Demassieux, N.**
 (1913) Compt. rend., 156, 892.
 (1914) Compt. rend., 158, 183, 702.
 (1923) Ann. chim., [9], 20, 233-96.
 (1923) Compt. rend., 177, 51.
- Demassieux, N. and Roger, L.**
 (1937) Compt. rend., 204, 1818-9.
- Denham, H. G.**
 (1917) J. Chem. Soc. (Lond.), 111, 39.
 (1918) J. Chem. Soc. (Lond.), 113, 249-56.
- Denham, H. G. and Dick, D. A.**
 (1931) J. Am. Chem. Soc. (Lond.), 1753-7.
- Denham, H. G. and Fife, C. V.**
 (1933) J. Chem. Soc. (Lond.), 1416-19.
- Denham, H. G. and Kidson, J. O.**
 (1931) J. Chem. Soc. (Lond.), 1757-61.
- Denham, H. G. and King, W. E.**
 (1935) J. Chem. Soc. (Lond.), 1251-3.
- Dennis, L. M. and Bridgman, J. A.**
 (1918) J. Am. Chem. Soc., 40, 1557-60.
- De Right, R. E.**
 (1933) J. Phys. Chem., 37, 405-16.
- Dernby, K. G.**
 (1918) Medd. k. Vetenskapsakad. Nobel inst., 3, No. 18.
- Desvergnès, L.**
 (1920) Ann. Chim. anal., [2], 2, 279-85.
- Deszathy.**
 (1893) Monatsh. Chem., 14, 249.
- Dhar, N. R.**
 (1926) Z. anorg. allgem. Chem., 153, 323-331.
 (1926a) Z. anorg. allgem. Chem., 155, 42-7.
- Dhar, N. and Datta, K.**
 (1913) Z. Elektrochem., 19, 584.
- Diacon.**
 (1866) Jahrsber. Chem., 61.
- Diaz de Rada F. and Bermejo, A. G.**
 (1929) Anales. soc. Espan. fis. quim. 27, 701-11.
- Dibbits.**
 (1874) Z. anal. Chem., 13, 139.
 (1874) J. prakt. Chem., [2], 10, 417, 439.
- Di Capua, Clara.**
 (1929) Gazz. chim. ital., 59, 164-9.
- Di Capua, C. and Bertoni, A.**
 (1928) Gazz. chim. ital., 58, 249.
- Di Capua, C. and Scaletti, U.**
 (1927) Gazz. chim. ital., 57, 391-9.
- Dice, M. E. and Hildebrand, J. H.**
 (1928) J. Am. Chem. Soc., 50, 3023-7.
- Dieterich.**
 (1890) Pharm. Centr., 31, 395.
- Dietrich, H. G.**
 (1929) J. Phys. Chem., 33, 95-8.
- Dietrich, H. G. and Johnston, J.**
 (1927) J. Am. Chem. Soc., 49, 1419-31.
- Dietz.**
 (1898) Pharm. Ztg., 43, 290.
 (1899) Z. anorg. Chem., 20, 260.
 (1899) Ber., 32, 95.
 (1900) Wiss. Abt. p. t. Reichsanstalt, 3, 433.
- Dietzel, R. and Sedlmeyer, J.**
 (1928) Arch. Pharm., 266, 507-517.
- Distanow, G. K.**
 (1937) Zhurnal. Obs. Khimii, 7, 676-80.
- Ditte, A.**
 (1875) Compt. rend., 30, 1164.
 (1877) Compt. rend., 85, 1069.
 (1881) Compt. rend., 92, 242, 718.
 (1881) Ann. chim. phys. [5], 24, 226.
 (1896) Compt. rend., 123, 1282.
 (1897) Compt. rend., 124, 30.
 (1898) Ann. chim. phys., [7], 14, 294.

AUTHOR INDEX

- Dittmar.**
(1888) J. Soc. Chem. Ind., 7, 730.
- Dittrich, C.**
(1899) Z. physik. Chem. 29, 485.
- Divers.**
(1870) J. Chem. Soc. (Lond.), 23, 171.
(1899) J. Chem. Soc. (Lond.), 75, 86.
- Dobbins, J. T. and Addleston, J. A.**
(1935) J. Phys. Chem., 39, 637-42.
- Dobbins, J. T. and Byrd, R. M.**
(1931) J. Phys. Chem., 35, 3673-6.
- Dobbins, J. T. and Thomas, L. C.**
(1937) J. Phys. Chem., 41, 655-661.
- Dobroserdow, D. and Erdmann, W. O.**
(1926) Ukrainskii. Chim. J., 2, 119.
- Dobson, H. J. S. and Masson, J.**
(1924) J. Chem. Soc. (Lond.), 125, 675.
- Doerinckel, F.**
(1907) Metallurgie, 8, 201-9, 408.
- Dolezalek, F. and Finckli, K.**
(1906) Z. anorg. Chem., 51, 320-7.
- Dolique, R.**
(1934) Bull. Soc. Chim. (France) [5] 1, 1745-52.
- Dombrowskaya, O. S.**
(1933) Zhurnal. Obs. Khimii, 3, 1017-25.
- Dombrowskaya, O. S. and Klatchko, M. A.**
(1933) Zhurnal. Obs. Khimii, 3, 1007-39.
- Dominik, W.**
(1922) Przemysl. Chem., 6, 317-27.
- Domontovitch, M. K. and Sarubina, O. V.**
(1925) Biochem. Z., 163, 464-9.
- Donald, M. B.**
(1937) J. Chem. Soc. (Lond.), 1325.
- Donath, E.**
(1911) Chem. Ztg., 35, 773-4.
- Donk, A. D.**
(1908) Chem. Weekblad, 5, 529, 629, 767.
(1916) Chem. Weekblad, 13, 92-97.
- Donk, M. G.**
(1905) Bull. No. 90, Bureau Chem. U.S. Dept. Agr.
- Donnan, F. G. and Burt, B. C.**
(1903) J. Chem. Soc. (Lond.), 83, 335.
- Donnan, F. G. and Thomas, J. S.**
(1911) J. Chem. Soc. (Lond.), 99, 1788.
- Donnan, F. G. and White, A. S.**
(1911) J. Chem. Soc. (Lond.), 99, 1669.
- Donskaja, D. B. and Portnow, M. A.**
(1939) Zhurnal Obs. Khimii., 9, 526-31.
- Dorfman, M. E. and Hildebrand, J. H.**
(1927) J. Am. Chem. Soc., 49, 729-37.
- Dornte, R. W. and Ferguson, C. V.**
(1939) Ind. Eng. Chem., 31, 112-3.
- van Dorp, G. C. A.**
(1910) Z. physik. Chem., 73, 284-289.
(1911) Chem. Weekblad., 8, 269.
(1912) 8th Internat. Cong. Appl. Chem., 22, 239.
(1913-14) Z. physik. Chem., 86, 109.
- Dott, D. B.**
(1906) Pharm. Jour. (Lond.), 76, 345.
- Doyer, J. W.**
(1890) Z. physik. Chem., 6, 481.
- Draper.**
(1887) Chem. News., 55, 169.
- Dresser, A. L., Browne, A. W. and Mason, C. W.**
(1933) J. Am. Chem. Soc., 55, 1963-7.
- van Driel, M.**
(1935) Z. anorg. Chem., 223, 318.
- Driot.**
(1910) Compt. rend., 150, 1426.
- Drucker, K.**
(1901) Z. anorg. Chem., 28, 362.
(1912) Z. Elektrochem., 18, 246.
- Drucker, K. and Moles, E.**
(1910) Z. physik. Chem., 75, 405.
- Duboin, A.**
(1905) Compt. rend., 141, 385.
(1906) Compt. rend., 142, 395, 573, 887, 1338.
- Dubourg, J.**
(1931) Bull. Assoc. Chemists. Suc. Dist. Ind. Agr. 48, 297-306.
- Duboux, M. and Cattat, L.**
(1921) Helv. Chim. Acta, 4, 735-61.
- Dubrisay, René.**
(1911) Compt. rend., 153, 1077.
(1912) Compt. rend., 154, 431.
- Dubrisay, R. and Francois, R.**
(1931) Compt. rend., 192, 741.
- Dubrisay, R. and Saint Maxen, A.**
(1936) Compt. rend., 203, 584-6.

AUTHOR INDEX

- Dubrisay and Toquet.**
(1919) Bull.soc.chim.,[4],25,354-64.
- Dukelski, M. P.**
(1906) Z.anorg.Chem.,50,42.
(1907) Z.anorg.Chem.,53,327-337;
54,45-9.
(1907) J.Russ.Phys.Chem.Soc.,39,
975-88.
(1909) Z.anorg.Chem.,62,114-8.
- Duncan, M. L.**
(1923) J. Am. Chem. Soc.,45,2660.
- Dundon, M. L. and Henderson, W. E.**
(1922) J. Am. Chem. Soc.,44,1196-1203.
- Dunn.**
(1882) Chem. News,45,272.
- Dunn, L. J. and Philip, J. C.**
(1934) J. Chem. Soc. (Lond.),658-666.
- Dunnicliff, H. B., Aggarval, A. L. and Hoon, R. C.**
(1928) J. Phys. Chem.,32,1697-1704.
- Dunnicliff, H. B. and Hoon, I. S. C.**
(1926) J. Phys. Chem.,30,1211-18.
- Dunningham, A. C.**
(1912) J. Chem. Soc. (Lond.),101,431-43.
(1914) J. Chem. Soc. (Lond.),105,368-79,
733,2630.
- Dunnington and Long.**
(1899) Am. Chem. Jour.,22,217.
- Duparc, L., Wenger, P. and Graz, G.**
(1925) Helv. Chim. Acta,8,280-294.
- Dupre and Bialas.**
(1903) Z. angew. Chem.,16,55.
- Early, R. G. and Lowry, T. H.**
(1919) J. Chem. Soc.,115,1387-1404.
(1922) J. Chem. Soc.,121,963-9.
- Ebelmen.**
(1852) Liebig's Ann.,[3],5,189.
- Eberly, N. E., Gross, C. V. and Crowell, W. S.**
(1920) J. Am. Chem. Soc.,42,1433-9.
- Edeleanu, L.**
(1923) Z. angew. Chem.,36,573-80.
- Eder.**
(1876) Dingler polyt. J.,221,89,189.
(1878) J. prakt. Chem.,[2],17,45.
(1880) Sitzber. k. Akad. Wiss. (Wien),
82, Abt. II,1284.
- Eggink, B. G.**
(1908) Z. physik. Chem.,64,492.
- Ehlert, H. and Hempel, W.**
(1912) Z. Elektrochem.,18,727.
- Ehret, Wm. F.**
(1932) J. Am. Chem. Soc.,54,3126-34.
- Eichelberger, W. C.**
(1934) J. Am. Chem. Soc.,56,801.
- Eitel.**
(1922) N. Jahrb. Min. II,45
(1923) N. Jahrb. Min. Beil. Bd.,48,63.
(1925) Tschermin. Petr. Mitt.,38,1-38.
- Ekwald, Per**
(1933) Z. anorg. Chem.,210,337-49.
- Ekwald, Per and Mylius, W.**
(1932) J. prakt. Chem.,135,133-6.
- Elchardus, E. and Lafitte, P.**
(1932) Bull. soc. chim. (France),51,
1572-9.
- Elgersma, J. N.**
(1929) Rec. trav. chim.,48,765-9
- Elliott, G. A., Kleist, L. L., Wilkins, F. J. and Webb, H. W.**
(1926) J. Chem. Soc.,129,1231.
- Elliott, L. D.**
(1924) J. Phys. Chem.,28,887-8.
- Elöd, E. and Acker, E.**
(1928) Z. anorg. chem.,176,305-24.
- Elöd, E. and Tremmel, K.**
(1927) Z. anorg. Chem.,165,161-170.
- Emerson, W. H.**
(1907) J. Am. Chem. Soc.,29,1750-6.
- von Ende, C. L.**
(1901) Z. anorg. Chem.,26,148.
- v. Endredy, A.**
(1934) Z. anorg. Chem.,217,59.
- Engel.**
(1886) Compt. rend.,102,114.
(1887) Compt. rend.,104,507,913.
(1888) Ann. chim. phys.,[6],13,
348-85.
(1889) Ann. chim. phys.,[6],17,347.
(1891) Bull. soc. chim.,[3],6,17.
- Englund, B.**
(1930) J. prakt. Chem.,121,191.

AUTHOR INDEX

- Epik, P. A.
(1932) Z. anal. Chem., **89**, 17-23.
- Eppel.
(1899) Dissertation, Heidelberg.
- Epstein, D. A.
(1939) Zhur. Obs. Khimii, **9**, 788-91.
- Epstein, D. A. and Kosterina, Z. N.
(1939) Zhur. Obs. Khimii, **9**, 625-7.
- Erbacher, O.
(1930) Ber. **63**, 141-56.
- Erbacher, O. and Nikitin, B.
(1931) Z. physik. Chem. (A), **158**, 216-30.
- Erdmann.
(1893) Ber., **26**, 2439.
- Erdmann and Bedford.
(1904) Ber., **37**, 1184.
- Eskola,
(1922) Am. J. Sci., [5], **204**, 331.
- Estreicher.
(1899) Z. physik. Chem., **31**, 184.
- Etard.
(1877) Compt. rend., **84**, 1090.
(1884) Compt. rend., **98**, 1434.
(1894) Ann. chim. phys., [7], **2**, 526-70;
3, 275.
- Ettinger, J.
(1932) Z. anorg. Chem., **206**, 260-2.
- Enell.
(1899) Pharm. Centralh., **38**, 181.
(1899) Z. anal. Chem., **38**, 386.
- Enklaar, J. E.
(1901) Rec. trav. chim., **20**, 183.
- Ephraim, F.
(1923) Ber., **56B**, 1530-42.
- Ephraim, F. and Flügel, W.
(1924) Helv. Chim. Acta, **7**, 724-40.
- Ephraim, F. and Mosimann, P.
(1922) Ber., **55B**, 1608-19.
- Ephraim, F. and Pfister, A.
(1925a) Helv. Chim. Acta., **8**, 229-41.
(1925) Helv. Chim. Acta., **8**, 369-83.
- Ephraim, F. and Seger, E.
(1925) Helv. Chim. Acta, **8**, 724-39.
- von Euler, H.
(1903) Ber., **36**, 2879, 3400.
(1904) Z. physik. Chem., **49**, 315.
(1916) Z. physik. Chem., **97**, 291.
- Euwes, P. C. J.
(1909) Rec. trav. chim., **28**, 298-338.
- Evans, T. W.
(1936) Ind. Eng. Chem., **8**, 206-8.
- Eversole, W. G. and McLachlan, R. W.
(1932) J. Am. Chem. Soc., **54**, 864-9.
- E'we, George E.
(1920) Proc. Penn. Pharm. Assoc.
- Ewers, Erich.
(1910) Milchwirtschaft. Zentr., **6**, (3?), 155.
- Ewing, W. W.
(1927) J. Am. Chem. Soc., **49**, 1963-73.
- Ewing, W. W., Brander, J. D. Slichter, C. B. and Griesinger, W. K.
(1933) J. Am. Chem. Soc., **55**, 4822-4.
- Ewing, W. W. and Klinger, E.
(1933) J. Am. Chem. Soc., **55**, 4825-7.
- Ewing, W. W., Krey, N. L., Law, H. and Lang, E.
(1927) J. Am. Chem. Soc., **49**, 1958-62.
- Ewing, W. W., McGovern, J. J. and Mathews, G. E. Jr.
(1933) J. Am. Chem. Soc., **55**, 4827-30.
- Ewing, W. W., Richard, A. J., Taylor, Wm. J., Jr. and Winkler, D. W.
(1933) J. Am. Chem. Soc., **55**, 4830-2.
- van Eyk, see Van Eyk.
- Fabris, E.
(1921) Gazz. chim. ital., **51**, II, 374-80.
(1931) Gazz. chim. ital., **61**, 527-37.
(1932) Gazz. chim. ital., **62**, 909-12.
- Fahrion, W.
(1916) Chem. Umschau, **23**, 34-5.
- Failey, C. F.
(1932) J. Am. Chem. Soc., **54**, 576-9.
(1932a) J. Am. Chem. Soc., **54**, 2367-71.
(1933) J. Am. Chem. Soc., **55**, 4374-8.
(1933a) J. Am. Chem. Soc., **55**, 3112-6.
- Fairbrother, F. and Balkin, M.
(1931) J. Chem. Soc. (Lond.), 1564.
- Fairhall, L. T.
(1924) J. Am. Chem. Soc., **46**, 1593-8.
(1924a) J. Biol. Chem., **60**, 481-4.

AUTHOR INDEX

- Fajans, K. Fischler, J. and Lambert, M.,**
(1916) *Z. anorg. allgem. Chem.*, **95**, 284-339.
- Fajans, K. and Karagunis.**
(1931) *Z. physik. Chem. (Bodenstein)*, **553**.
- Falciola, P.**
(1910) *Gazz. chim. ital.*, **40**, II, 218.
(1910) *Seifens Ztg.*, **38**, 506.
- Falinski, Marie.**
(1936) *Compt. rend.*, **203**, 877-9.
- Farrow, M.**
(1926) *J. Chem. Soc.*, **129**, 49-55.
(1927) *J. Chem. Soc. (Lond.)*, **1153-8**.
- Fastert, C.**
(1912) *Kali*, **[6]**, 454.
(1912) *Neue Jahrb. Min. Geol. (Beil. Bd.)*,
33, 286.
- Faust, O. and Esselmann, P.**
(1926) *Z. anorg. allgem. Chem.*, **157**, 290-8.
- Fauzer.**
(1888) *Math. u. Natur. Wiss. Ber. (Ungarn)*,
6, 154.
- Fedotieff, P. P.**
(1904) *Z. physik. Chem.*, **49**, 168.
(1910-11) *Z. anorg. Chem.*, **69**, 26.
(1911-12) *Z. anorg. Chem.*, **73**, 178.
(1928) *Z. anorg. Chem.*, **173**, 81.
- Fedotieff, P. P. and Iljinsky.**
(1913) *Z. anorg. Chem.*, **80**, 119.
(1923) *Z. anorg. Chem.*, **129**, 93-107.
- Fedotieff, P. P. and Kolossoff, A.**
(1923) *Z. anorg. allgem. Chem.*, **130**,
39-46.
- Fedotieff, P. P. and Koltunoff, J.**
(1914) *Z. anorg. Chem.*, **85**, 251.
- Fedotieff, P. P. and Timofieff, K.**
(1932) *Z. anorg. Chem.*, **206**, 263.
- Feit, W.**
(1931) *Z. anorg. Chem.*, **199**, 268.
- Feit, W. and Przibylla, K.**
(1909) *Z. Kali*, **3**, 393-8.
- Feitknecht, W.**
(1930) *Helv. chim. acta.*, **13**, 22-43.
- Felsing and Durban.**
(1926) *J. Am. Chem. Soc.*, **48**, 2885.
- Fenton, H. J. H.**
(1898) *J. Chem. Soc. (Lond.)*, **73**, 479.
- Ferchland.**
(1902) *Z. anorg. Chem.*, **30**, 133.
- Fernandes, L.**
(1925) *Gazz. chim. ital.*, **55**, 1-6.
- Ferner, S. W. and Mellon, M. G.**
(1934) *Ind. End. Chem. Anal. Ed.*, **6**, 345-8.
- Ferrari, A. and Baroni.**
(1928) *Atti. accad. Lincei* **[6]**, **7**, 848,
1040.
- Ferrari, A. Celeri and Giorgi.**
(1929) *Atti accad. Lincei* **[6]**, **9**, 782.
- Ferrari, A. and Colla, C.**
(1931) *Atti accad. Lincei* **[6]**, **13**, 78-80.
(1933) *Atti accad. Lincei* **[6]**, **17**, 312-7,
473-5.
(1937) *Gazz. Chim. ital.*, **67**, 88-94.
- Ferrari, A. and Inganni.**
(1928) *Atti accad. Lincei*, **[6]**, **10**, 253-8.
(1930) *Atti accad. Lincei* **[6]**, **12**, 668-71.
- Ferrero, P. and Bolliger, G.**
(1928) *Helv. Chim. acta.*, **11**, 1143-51.
- Feulgen, R. and Rossenbeck, H.**
(1923) *Z. physiol. Chem.*, **125**, 284-8.
- Fialkow, J. A. and Kensmenko, A. A.**
(1936) *Zhur. Obs. Khimii*, **6**, 265-72.
- Field.**
(1859) *J. Chem. Soc. (Lond.)*, **11**, 6.
- Fierz-David, H. E., Krebsler, A. and Anderau, W.**
(1927) *Helv. chim. acta*, **10**, 197-227.
- Findlay, Alex.**
(1902) *J. Chem. Soc. (Lond.)*, **81**, 1217.
(1904) *J. Chem. Soc. (Lond.)*, **85**, 403.
(1908) *Chem. News*, **96**, 163.
(1908) *Analyst*, **33**, 391.
- Findlay, Alex. and Campbell, A. N.**
(1930) *J. Chem. Soc. (Lond.)*, **2721-4**.
- Findlay, Alex. and Creighton, H. J. M.**
(1910) *J. Chem. Soc. (Lond.)*, **97**, 536-61.
(1911) *Biochem. Jour.*, **5**, 294.
- Findlay, A. and Cruickshank, J.**
(1926) *J. Chem. Soc.*, **129**, 316-8.
- Findlay, A. and Howell, O. R.**
(1914) *J. Chem. Soc. (Lond.)*, **105**, 291-98.
(1915) *J. Chem. Soc. (Lond.)*, **107**, 282-4.

AUTHOR INDEX

- Hay, Alex. and King, G.
 (1913) J. Chem. Soc. (Lond.), 103, 1170.
 (1914) J. Chem. Soc. (Lond.), 105, 1297.
- Hay, Alex., Morgan, I. and Morris, I. P.
 (1914) J. Chem. Soc. (Lond.), 105, 779-82.
- Hay, Alex. and Shen, B.
 (1911) J. Chem. Soc. (Lond.), 99, 1313.
 (1912) J. Chem. Soc. (Lond.), 101, 1459-68.
- Hay, Alex. and Williams, T.
 (1913) J. Chem. Soc. (Lond.), 103, 636.
- H. B. and Watson, F. S.
 (1923) J. Soc. Chem. Ind., 42, 308.
- Her, Emil.
 (1906) Ber., 39, 4144-5.
- Her, E. and Plähler, E.
 (1920) Ber., 53B, 1616-7.
- Her, F. and Pfeleiderer, G.
 (1922) Z. anorg. allgem. Chem., 124, 61-9.
- Her, V. M.
 (1914) J. Russ. Phys. Chem. Soc., 46, 1250-1270.
 (1918) Z. physik. Chem., 92, 581-99.
- Her, V. M. and Miloszewski, F.
 (1910) Kosmos (Lemberg), 35, 538-42.
 (1910) Chem. Zentr., 11, 1048.
- H. R.
 (1923) Dissertation, Zurich
- H. R. and Jordan, A.
 (1930) Bull. Soc. Chim., [4], 47, 246.
 (1933) Helv. chim. acta, 16, 37-53.
- H. W. F.
 (1909) J. Russ. Phys. Chem. Soc., 41, 739.
- H. J.
 (1937) Bull. soc. chim., [5], 4, 558-60.
- H. E.
 (1905) Physik. Z., 6, 419.
- H. P. and Wells, L. S.
 (1934) J. Res. U. S. Bureau Standards, 12, 751-783.
- H. Fr.
 (1928) Z. anorg. Chem., 73, 1-39.
- H. G.
 (1887) Arch. Pharm., [3], 25, 542.
- H. C.
 (1897) Z. Kryst. Min., 28, 365, 397.
- Foerster, F., Brosche, A. and Norberg-Schulz, Chr.
 (1924) Z. physik. Chem., 110, 435-496.
- Foerster, F. and Kubel, K.
 (1924) Z. anorg. allgem. Chem., 139, 269.
- Fonda, G.
 (1910) Dissertation, Karlsruhe.
- Fontein, F.
 (1910) Z. physik. Chem., 73, 212-251.
- Fonzes-Diacon.
 (1895) J. pharm. chim., [6], 1, 59.
- Foote, H. W.
 (1903) Am. Chem. Jour., 30, 341.
 (1903) Z. physik. Chem., 46, 81.
 (1904) Am. Chem. Jour., 32, 252.
 (1907) Am. Chem. Jour., 37, 124.
 (1910) J. Am. Chem. Soc., 32, 618-22.
 (1912) J. Am. Chem. Soc., 34, 880.
 (1915) J. Am. Chem. Soc., 37, 290, 1200.
 (1919) Ind. Eng. Chem., 11, 629-31.
 (1920) J. Am. Chem. Soc., 42, 266.
 (1921) J. Am. Chem. Soc., 43, 1031-8.
 (1923) J. Am. Chem. Soc., 45, 663-7.
 (1925) Am. J. Sci., [5], 9, 441-7.
 (1927) Am. J. Sci., [5], 13, 158.
- Foote, H. W. and Andrew, I. A.
 (1905) Am. Chem. Jour., 34, 153, 165.
- Foote, H. W. and Bradley, W. M.
 (1932) J. Phys. Chem., 36, 673-8.
 (1933) J. Phys. Chem., 37, 29-31.
 (1936) J. Am. Chem. Soc., 58, 930-1.
- Foote, H. W., Bradley, W. M. and Fleischer, M.
 (1933) J. Phys. Chem., 37, 21-7.
- Foote, H. W. and Brinkley, S. R.
 (1921) J. Am. Chem. Soc., 43, 1018-31.
- Foote, H. W. and Chalker, W. C.
 (1908) Am. Chem. Jour., 39, 564, 567.
- Foote, H. W. and Fleischer, J.
 (1931) J. Am. Chem. Soc., 53, 1752-63.
 (1934) J. Am. Chem. Soc., 56, 870-3.
- Foote, H. W. and Haigh, F. L.
 (1911) J. Am. Chem. Soc., 33, 459.
- Foote, H. W. and Hickey, F. C.
 (1927) J. Am. Chem. Soc., 56, 648-50.
- Foote, H. W. and Hunter, M. A.
 (1920) J. Am. Chem. Soc., 42, 69-78.

AUTHOR INDEX

- Foote, H. W. and Levy.**
(1907) *Am. Chem. Jour.*, **37**, 119.
- Foote, H. W. and Saxon, Blair.**
(1914) *J. Am. Chem. Soc.*, **36**, 1695.
- Foote, H. W. and Schairer, J. F.**
(1930) *J. Am. Chem. Soc.*, **52**, 4202-17.
- Foote, H. W. and Smith, S. B.**
(1924) *J. Am. Chem. Soc.*, **46**, 84-8.
- Foote, H. W. and Vance, J. E.**
(1928) *Am. J. Sci.*, [5], **16**, 68-72.
(1929) *Am. J. Sci.*, [5], **17**, 425-30.
(1929a) *Am. J. Sci.*, [5], **18**, 375-82.
(1930) *Am. J. Sci.*, [5], **19**, 203-13.
(1933) *Am. J. Sci.*, [5], **25**, 499-502.
(1933a) *Am. J. Sci.*, [5], **26**, 16-18.
- Foote, H. W. and Walden, P. T.**
(1911) *J. Am. Chem. Soc.*, **33**, 1032.
- Forbes, G. S.**
(1911) *J. Am. Chem. Soc.*, **33**, 1937.
- Forbes, G. S. and Cole, H. I.**
(1921) *J. Am. Chem. Soc.*, **43**, 2492-7.
- Forbes, J. C.**
(1931) *J. Biol. Chem.*, **93**, 255-68.
- de Forcrand, R.**
(1909) *Compt. rend.*, **149**, 719.
(1909a) *Compt. rend.*, **149**, 1344.
(1911) *Compt. rend.*, **152**, 1210.
- de Forcrand, and Fonzes-Diacon.**
(1902) *Ann. chim. phys.*, [7], **26**, 253.
- Foret, Mlle.**
(1931) *Compt. rend.*, **193**, 1423.
- Formanek.**
(1887) *Chem. Centralbl.*, **18**, 270.
- Foster, B. and Neville, H. A. D.**
(1910) *Proc. Chem. Soc.*, **26**, 236.
- Fox, Chas. J. J.**
(1902) *Z. physik. Chem.*, **41**, 458.
(1903) *Z. anorg. Chem.*, **35**, 130.
(1909) *J. Chem. Soc. (Lond.)*, **95**, 878-89.
(1909a) *Trans. Faraday Soc.*, **5**, 68.
- Fox, Chas. J. J. and Gauge, A. J. H.**
(1910) *J. Chem. Soc. (Lond.)*, **97**, 377-85.
- Fraenckel, F.**
(1907) *Z. anorg. Chem.*, **55**, 223-32.
- Freeman, D., Laybourn, K. and Madgin, W. M.**
(1933) *J. Chem. Soc. (Lond.)*, 648-50.
- Freese.**
(1920) *Chem. Ztg.*, **44**, 294.
- Freeth, F. A.**
(1922) *Phil. Trans. Roy. Soc. (Lond.)*, Ser. A, **223**, 35-87.
(1924) *Dissertation*, Leiden.
(1924) *Rec. trav. chim.*, **43**, 475-507.
- Frere, Francis. J.**
(1936) *J. Am. Chem. Soc.*, **58**, 1695-7.
- Fresenius.**
(1846) *Liebig's Annalen*, **59**, 118.
(1890) *Z. anal. Chem.*, **29**, 418.
(1891) *Z. anal. Chem.*, **30**, 672.
- Francois, M.**
(1900) *Compt. rend.*, **130**, 1024.
(1935) *Compt. rend.*, **200**, 393-5.
(1935) *Compt. rend.*, **201**, 215-6, 1489-91.
(1937) *Bull. Soc. Chim.*, [5], **4**, 736-8.
- Francois, F. and Delwaulle, M. L.**
(1936) *Bull. soc. chim.*, [5], **3**, 687-96.
- Francois, M. and Lormand, Ch.**
(1923) *J. pharm. chim.*, [7], **28**, 438.
(1923) *Ann. fals.*, **16**, 602-9.
- Frankforter, G. B. and Cohen, Lillian.**
(1914) *J. Am. Chem. Soc.*, **36**, 1103-34.
(1916) *J. Am. Chem. Soc.*, **38**, 1139.
- Frankforter, G. B. and Frary, F. C.**
(1913) *J. Phys. Chem.*, **17**, 402-73.
- Frankforter, G. B. and Temple, S.**
(1915) *J. Am. Chem. Soc.*, **37**, 2697-2716.
- Fraps, G. S.**
(1901) *Am. Chem. Jour.*, **27**, 290.
- Frear, G. L. and Johnston, J.**
(1929) *J. Am. Chem. Soc.*, **51**, 2082-93.
- Fredenhagen, Karl.**
(1931) *Z. Elektrochem.*, **37**, 686.
(1933) *Z. physik. chem.*, **165**(A), 179.
- Fredenhagen, K. and Cadenbach, G.**
(1930) *Z. physik. Chem.*, **146**(A) 245-280.
- Fredholm, H.**
(1934) *Z. anorg. Chem.*, **217**, 203-13.
(1934) *Z. anorg. Chem.*, **218**, 225-40.
- Free, E. E.**
(1908) *J. Am. Chem. Soc.*, **30**, 1366-74.

AUTHOR INDEX

- Freundlich, H. and Söllner, K.**
(1928) *Biochem. Ztschr.*, **203**, 3-13.
- Fricke, R.**
(1928) *Z. anorg. Chem.*, **172**, 234.
- Fricke, R. and Blencke, W.**
(1925) *Z. anorg. allgem. Chem.*, **143**, 193.
- Fricke, R. and Brummer, F.**
(1933) *Z. anorg. Chem.*, **213**, 319-20.
(1935) *Z. anorg. Chem.*, **223**, 397-8.
- Fricke, R. and Humme, H.**
(1929) *Z. anorg. Chem.*, **178**, 400-10.
- Fricke, R. and Jucaitis, P.**
(1930) *Z. anorg. Chem.*, **191**, 129-149.
- Fricke, R. and Rode, O.**
(1927) *Z. anorg. Chem.*, **163**, 31-9.
- Fricke, R. and Windhausen, O.**
(1924) *Z. anorg. allgem. Chem.*, **132**, 226.
- Fridel.**
(1869) *Liebig's Ann.*, **149**, 96.
- Friedel and Lachburg.**
(1869) *Bull. soc. chim.*, **[2]**, **12**, 92.
- Friedländer, T.**
(1901) *Z. physik. Chem.*, **38**, 389.
- Friedlander, F. V.**
(1918) *J. Am. Chem. Soc.*, **40**, 1945-7.
- Friedman, H. B. and LaMer, V. K.**
(1931) *J. Am. Chem. Soc.*, **53**, 103-5.
- Friedrich, K.**
(1907) *Metallurgie*, **4**, 480, 671.
(1908) *Metallurgie*, **5**, 114.
(1914) *Metallurgie u. Erz.*, **11**, 79, 196-200.
- Friedrichs, F.**
(1921) *Z. anorg. allgem. Chem.*, **116**, 141-60.
- Friend, J. A. N.**
(1929) *J. Chem. Soc. (Lond.)*, 2330-3, 2782-3.
(1930) *J. Chem. Soc. (Lond.)*, 1633-42, 1903-8.
(1931) *J. Chem. Soc. (Lond.)*, 1802-9, 2225-6.
(1932) *J. Chem. Soc. (Lond.)*, 1597-1602.
(1935) *J. Chem. Soc. (Lond.)*, 824-6, 1430-2.
- Friend, J. A. N. and Colley, A. T. W.**
(1931) *J. Chem. Soc. (Lond.)*, 3148-9.
- Friend, J. A. N., Hale, R. W. and Ryder, S. E. A.**
(1937) *J. Chem. Soc. (Lond.)*, 970.
- Friend, J. A. N. and Smirles, W. N.**
(1928) *J. Chem. Soc. (Lond.)*, 131, 2242-5.
- Friend, J. A. N., Townley, J. E. and Vallance, R. H.**
(1929) *J. Chem. Soc. (Lond.)*, 2326-30.
- Friend, J. A. N. and Wheat, W. N.**
(1935) *J. Chem. Soc. (Lond.)*, 356-9.
(1939) *J. Chem. Soc. (Lond.)*, 501-2.
- Frisak, A.**
(1922) *Metal. u. Erz.*, **19**, 200.
- Frisch, Franz.**
(1930) *Helv. Chim. acta*, **13**, 768-85.
- Froehlich, W.**
(1929) *Mitt. Kali Forsch. Anstalt*, **68**, 37.
- Fröhlich, K. W.**
(1929) *Dissertation*, Münster.
- Frolich, K., Tauch, E. J., Hogan, J. J. and Peer, A. A.**
(1931) *Ind. Eng. Chem.*, **23**, 548-550.
- Fronmüller.**
(1878) *Ber.*, **11**, 92.
- Frost, O. I.**
(1936) *Zhur. Obs. Khimii*, **6**, 1910-12.
- Frost, W. S., Cothran, J. C. and Browne, A. W.**
(1933) *J. Am. Chem. Soc.*, **55**, 3516.
- Frowein, Fr.**
(1928) *Z. anorg. Chem.*, **169**, 336-44.
- Frowein, F. and von Muhlendahl, E.**
(1926) *Z. angew. Chem.*, **39**, 1488-1500.
- Frumkin, A. and Kul'vaskaja, R.**
(1924) *Z. anorg. allgem. Chem.*, **138**, 278-80.
- Fuchs, Paul.**
(1929) *Ber.*, **62**, 1535.
- Fühner,**
(1924) *Ber.*, **57**, 510.
- Fujimura, T.**
(1914) *Mem. Col. Sci. Kyoto*, **1**, 63-68.
- Fulda, W.**
(1909) *Arb. Kais. Gesundheitsamt*, **30**, 31.
- Funk, R.**
(1899) *Z. anorg. Chem.*, **20**, 412.
(1900) *Wiss. Abh. p. t. Reichsanstalt*, **3**, 440.
(1900a) *Ber.*, **33**, 3697.

AUTHOR INDEX

- Furcht, M. and Lieben, A.**
(1909) Sitzber. k. akad. Wiss. (Wien),
118, 11b, 383.
(1909) Monatsh. Chem., 30, 555.
- Fürth.**
(1888) Monatsh. Chem., 9, 311.
- Fuseya, G.**
(1920) J. Am. Chem. Soc., 42, 368-71.
- Fuseya, G., Mori and Imamura.**
(1933) J. Soc. Chem. Ind. (Japan) Suppl.
36, 175. B.
- Gahl, R.**
(1900) Z. physik. Chem., 33, 178-214.
- Galeotti, C. and Giampalmo, G.**
(1908) Z. Chem. Ind. Kolloide, 3, 118-25.
- Gallo, G.**
(1935) Ann. chim. applicata., 25, 628-31.
- Garner, W. E. and Masson, I.**
(1921) Phil. Mag., 41, 484.
- Garran, R. R.**
(1926) J. Chem. Soc., 129, 848-55.
- Garrett, A. B. and Hirschler, A. E.**
(1938) J. Am. Chem. Soc., 60, 299-306.
- Garrett, A. B. and Howell, W. W.**
(1939) J. Am. Chem. Soc., 61, 1730-4.
- Garrett, A. B., Vellenga, S. and Fontana, C. N.**
(1939) J. Am. Chem. Soc., 61, 367-73.
- Garrick, F. J. and Wilson, C. L.**
(1932) J. Chem. Soc. (Lond.), 835-41.
- Garside,**
(1875) Chem. News, 31, 245.
- Gaudechon, H.**
(1910) Compt. rend., 150, 467.
- Gaus.**
(1900) Z. anorg. Chem., 25, 236.
- Gay-Lussac.**
(1819) Ann. chim. phys., 11, 314.
- Geffcken, G.**
(1904) Z. physik. Chem., 49, 271-296.
- Geiger.**
(1904) Dissertation (Berlin).
- Geilmann, W. and Wrigge, F. W.**
(1931) Z. anorg. Chem., 197, 353-63.
- Geller, R. F., Creamer, A. S. and Bunting, E. M.**
(1934) J. Res. U. S. Bureau of Standards,
13, 237-244.
- Gemsky, N.**
(1914) Neues Jahrb. Min. Geol. (Beil.
Bd.), 36, 513-58.
- Genke, F. A.**
(1926) J. Russ. phys. chem. Soc., 58, 596.
- Gerard.**
(1901) Ann. chim. anal., 6, 59.
- Geradin.**
(1865) Ann. chim. phys., [4], 5, 129, 134,
147, 158.
- Gerassimow, J. I.**
(1930) Z. anorg. Chem., 187, 321-33.
(1931) U. S. S. R. Sci. Res. Dept. Supreme
Council Nat. Econ., No. 420;
Trans. Inst. pure chem. Res.
No. 11, 34.
(1934) Zhur. Obs. Khimii, 4, 721-2.
- Gerlach.**
(1869) Z. anal. Chem., 8, 250, 281.
(1889) Z. anal. Chem., 28, 473.
- Germann, F. E. E. and Metz, C. F.**
(1931) J. Phys. Chem., 35, 1944-52.
- Germann, A. F. O. and Booth, H. S.**
(1926) J. Phys. Chem., 30, 369-77.
- Germs, H. C.**
(1917) Dissertation, Gröningen.
- Germuth, F. G.**
(1931) J. Franklin, Inst., 212, 346.
- Getman, F. H.**
(1935) Rec. trav. chim., 54, 866-72.
- Ghiron, D. and Mangili, L.**
(1935) Gazz. chim. ital., 65, 1244-9.
- Ghiron, D. and Monticelli, M.**
(1938) Gazz. chim. ital., 68, 555-9.
- Gibby, C. W.**
(1934) J. Chem. Soc. (Lond.), 9-10.
- Gibson, G. C., Driscoll, J. O. and Jones, W. J.**
(1929) J. Chem. Soc. (Lond.), 1440-3.
- Gibson, W. H., Duckham, R. and Fairbairn, R.**
(1922) J. Chem. Soc., 121, 270-283.
- Gilbert, E. C.**
(1929) J. Phys. Chem., 33, 1235-46.
(1929a) J. Am. Chem. Soc., 51, 3394-3400.
- Gilbert, E. C. and Hoffman, E. H.**
(1932) J. Phys. Chem., 36, 2789-92.
- Gilbert, L. F.**
(1925) J. Chem. Soc., 127, 1541.

AUTHOR INDEX

- Gilbert, L. F., Buckley, H. and Masson, I.**
(1922) J. Chem. Soc., 121, 1934-8.
- Gill, H. W.**
(1914) J. Chem. Met. Soc. (S. Africa), 14, 290-2.
- van Ginneken, P. J. H.**
(1911) Verslag. k. Akad. Wet. (Amst.), 20, 337.
- Ginnings, P. M. and Chen, Z. T.**
(1931) J. Am. Chem. Soc., 53, 3765-9.
- Ginnings, P. M. and Dees, Mary**
(1935) J. Am. Chem. Soc., 57, 1038-40.
- Ginnings, P. M., Herring, Ethel and Webb, B.**
(1933) J. Am. Chem. Soc., 55, 875-8.
- Ginnings, P. M. and Robbins, D.**
(1930) J. Am. Chem. Soc., 52, 2282-6.
- Ginnings, P. M., Webb, B. and Hinohara, E.**
(1933) J. Am. Chem. Soc., 55, 4898-9.
- Ginsberg, A. S.**
(1906) Ann. Inst. Poly. (Petrograd), 6, 493.
(1908) Z. anorg. Chem., 59, 346.
(1909) Z. anorg. Chem., 61, 122.
- Ginsberg, H.**
(1932) Z. anorg. Chem., 204, 225-31.
- Giolitti, F. and Bucci, G.**
(1905) Gazz. chim. ital., 35, 11, 162-9.
- Giolitti, F. and Vecchiarelli, V.**
(1905) Gazz. chim. ital., 35, 11, 170.
- Giran, H.**
(1903) Jour. physique, [4], 2, 807.
(1903a) Ann. chim. phys., [7], 30, 249.
(1906) Compt. rend., 142, 398.
(1908) Compt. rend., 146, 270, 1270.
(1913) Bull. soc. chim., [4], 13, 1050.
- Giraud, H.**
(1885) Bull. soc. chim., [2], 43, 552.
- von Girsowald, C. and Wolokitin, A.**
(1909) Ber., 42, 856-9.
- Giua, M. and Guastalla, G.**
(1925) Gazz. chim. ital., 55, 646-52.
- Gjalbaek, J. K.**
(1925) Z. anorg. allgem., Chem., 144, 145, 269.
- Gladstone.**
(1854) J. Chem. Soc. (Lond.), 6, 11.
- Glass, H. M., Laybourn, K. and Madgin, W. M.**
(1932) J. Chem. Soc. (Lond.), 874, 2713-5.
(1933) J. Chem. Soc., (Lond.), 199-202.
- Glasstone, S.**
(1921) J. Chem. Soc., 119, 1689, 1914.
(1922) J. Chem. Soc., 121, 58-66.
(1922a) J. Chem. Soc., 121, 1456-80.
- Glasstone, S. and Riggs, E. J.**
(1925) J. Chem. Soc., 127, 2846-54.
- Glasstone, S. and Saunders, R. N.**
(1923) J. Chem. Soc., 123, 2134-40.
- Glauser, R. Th.**
(1910) Z. anorg. Chem., 66, 437.
- Glowczynski, Z.**
(1914) Kolloidchem. Beihefte, 6, 147-76.
- Gniewosz, St. and Walfisz, Al.**
(1887) Z. physik. Chem., 1, 70.
- Godeffroy.**
(1876) Ber., 9, 1337, 1369.
(1886) Z. öster. Apoth. Ver., No. 9.
- Goldblum, H. and Stoffella, G.**
(1910) J. chim. phys., 8, 154.
- Goldblum, H. and Terlikowski, F.**
(1912) Bull. soc. chim., [4], 11, 146-59.
- Goldschmidt, H.**
(1895) Z. physik. Chem., 17, 154.
(1898) Z. physik. Chem., 25, 95.
- Goldschmidt, H. and Eckardt, M.**
(1906) Z. physik. Chem., 56, 389.
- Goodman, J. B. and Krase, N. W.**
(1931) Ind. Eng. Chem., 23, 401-4.
- Goodwin, H. M. and Horsch, W. G.**
(1919) Chem. Met. Eng., 21, 181.
- Goodwin, W. L.**
(1882) Ber., 15, 3039.
- van der Goot, Tetta Polak.**
(1913) Z. physik. Chem., 84, 419-450.
- Gordon, V.**
(1895) Z. physik. Chem., 18, 1-16.
- Gore.**
(1870) Proc. Roy. Soc., 18, 158.
- Goria, C.**
(1935) Gazz. chim. ital., 65, 865, 1226.
- Gothe, E.**
(1915) Chem. Ztg., 39, 305-7.

AUTHOR INDEX

- Gott, B. S. and Muir, M. P.
(1888) J. Chem. Soc. (Lond.), **53**, 138.
- Goudriaan, F.
(1919) Verslag. Akad. Wetenschappen (Amsterdam), **28**, 159.
(1919) Proc. Acad. Sci. (Amsterdam), **22**, 179-189.
(1920) Rec. trav. chim., **39**, 505-14.
(1922) Rec. trav. chim., **41**, 82-95.
- Goubeau, J., Kollé, H. and Krall, H. G.
(1938) Z. anorg. Chem., **236**, 45-56.
- Grace, N. S.
(1931) J. Chem. Soc. (Lond.), 594-608.
- Graff, W.
(1933) Compt. rend., **196**, 1390.
(1933) Compt. rend., **197**, 754.
- Grahmann, W.
(1913) Z. anorg. Chem., **81**, 257-314.
- Grant, A. J. and James, C.
(1917) J. Am. Chem. Soc., **39**, 934.
- Graziadei, A.
(1935) Chimie et Ind., **33**, 183-92.
(1935) Chimie et Ind., **34**, 29-36.
(1936) Chimie et Ind., **36**, 31-6, 72-80.
- Greene, Chas. H.
(1937) J. Am. Chem. Soc., **56**, 1186-8.
- Green, W. F.
(1908) J. Phys. Chem., **12**, 655-60.
- Greenish, H. G.
(1900) Pharm. Jour. (Lond.), **65**, 190-95.
- Greenish, H. G. and Smith, F. A. U.
(1901) Pharm. Jour. (Lond.), **66**, 774-7, 806-11.
(1902) Pharm. Jour. (Lond.), **68**, 510-32.
(1903) Pharm. Jour. (Lond.), **71**, 881.
- Gregg-Wilson and Wright, R.
(1928) J. Chem. Soc. (Lond.), 3111.
- Grehant, N.
(1894) Compt. rend., **118**, 594.
- Greig.
(1927) Am. J. Sci. [5], **214**, 473-84.
- Grieve, A. D., Gurd, G. W. and Maass, O.
(1933) Canadian J. Res., **8**, 577-82.
- Griffith, R. O., McKeown, A. and Winn, A. G.
(1932) Trans. Faraday Soc., **28**, 101-7.
- Grimbert, L., Malmy, M. and Poirot, G.
(1924) J. pharm. chim., [7], **29**, 1-9.
- Gröger, Max.
(1911) Z. anorg. Chem., **70**, 135.
- Groh, J.
(1927) Z. anorg. Chem., **162**, 287-300.
- Grollman, A.
(1929) J. Biol. Chem., **82**, 317-25.
- Groschuff, E.
(1901) Ber., **34**, 3318.
(1903) Ber., **36**, 1791, 4351.
(1904) Ber., **37**, 1488.
(1905) Z. anorg. Chem., **47**, 331-52.
(1908) Z. anorg. Chem., **58**, 102, 113.
(1910) Chem. Weekblad., **7**, 687.
(1911) Z. Elektrochem., **17**, 348.
- Gross, P. and Iser, Maria.
(1930) Monatsheft. Chem., **55**, 329-337.
- Gross, P. and Klinghoffer, St. S.
(1930) Monatsheft. Chem., **55**, 338-41.
- Gross, P. and Schwarz, K.
(1930) Monatsheft. Chem., **55**, 287-306.
- Grossmann.
(1905) Z. anorg. Chem., **43**, 357.
- Grube, G.
(1914) Z. Elektrochem., **20**, 342.
(1927) Z. Elektrochem., **33**, 482.
- Grube, G. and Heune, H.
(1930) Z. Elektrochem., **36**, 129-35.
- Grube, G. and Herrmann, W.
(1936) Z. Elektrochem., **42**, 233-6.
- Grube, G. and Nussbaum, M.
(1928) Z. Elektrochem., **34**, 91-98.
- Grube, G. and Rüdél, W.
(1924) Z. anorg. allgem. Chem., **133**, 375-88.
- Grube, G. and Staesche, M.
(1927) Z. physik. Chem., **130**, 572-83.
- Gruttner, G.
(1914) Ber., **47**, 3259.
- Gudzeit, F.
(1908) Z. physiol. Chem., **56**, 150-179.
(1909) Z. physiol. Chem., **60**, 27, 38-68.
- Guemple, O.
(1929) Bull. soc. chim., Belg., **38**, 443-7.
- Guerassimow, J. I.
(1934) Zhur. Obs. Khimii, **4**, 723-7.
- Guerin, H.
(1938) Compt. rend., **206**, 1300.
(1939) Compt. rend., **208**, 1016-8.

AUTHOR INDEX

- Guerini, B.
(1912) Thesis, Lausanne.
- Guertier, W. and Schack, H.
(1923) Metall u Erz., 20, 162.
- Guertler.
(1904) Z. anorg. Chem., 40, 337.
- Guigues, P.
(1927) Bull. sci. Pharmacol., 34, 210-2.
- Guillier, R.
(1927) Caliche, 9, 292.
- Güntelberg, E. and Pedersen, K. O.
(1926) Z. physik. Chem., 123, 225-8.
- Guntz, A. and Guntz, Jr., A. A.
(1914) Ann. chim., 2, 101.
- Gurwitsch, L.
(1914) Z. physik. Chem., 87, 329.
- Guthrie,
(1875) Phil. Mag., [4], 49, 210.
(1876) Phil. Mag., [5], 1, 366.
(1878) Phil. Mag., [5], 6, 40.
(1884) Phil. Mag., [5], 18, 30, 504.
- Guthrie, A.
(1901) J. Soc. Chem. Ind., 20, 224.
- Guyer, A., Bieler, A. and Schmid, G.
(1934) Helv. chim. Acta, 17, 1530-44.
- Gyngell, E. S.
(1928) J. Chem. Soc. (Lond.), 1785-91.
- Haber-Chuwis, Q.
(1926) Rosz. Chem., 6, 700-4.
- Haber, F. (Jänicke, Matthias)
(1925) Z. anorg. Chem., 147, 156.
(1926) Z. anorg. Chem., 153, 153.
- Haber, F. and van Ordt, G.
(1904) Z. anorg. Chem., 38, 387.
- Hachmeister, K.
(1920) Z. anorg. allgem. Chem., 109, 145-86.
- Hackspill, L.
(1933) Helv. chim. Acta, 16, 1096.
- Haehnel, O.
(1920) Centr. Min. Geol., 25-30.
(1924) J. prakt. Chem., [2], 107, 165-76.
(1924) J. prakt. Chem., [2], 108, 61-74, 187-193.
(1937) J. prakt. Chem., [2], 148, 295-309.
- Haffert, N. H.
(1922) J. Soc. Chem. Ind., 41, 334.
- Hagen, H. and Sieverts, A.
(1930) Z. anorg. Chem., 185, 225, 238.
- Hager.
(1875) Chem. Zentralbl., 135.
(1903) "Handbuch de Pharmaceutischen Praxis." 3rd. Ed.
- Hager, G. and Kern, J.
(1916) J. Landw., 64, 325-42.
(1920) Chem. Abs., 14, 792.
- Hagisawa, H.
(1934) Sci. Reports Tohoku Univ. (1), 23, 182.
- Hahn.
(1877) Wyandotte Silver Smelting Works.
- Hahn, F. L. and Brunnigässer, K.
(1926) Z. anorg. allgem. Chem., 153, 77-96.
- Hahn, F. L. and Klockmann, R.
(1930) Z. physik. Chem., (A), 146, 394.
- Hahn, F. L. and Schulze, R.
(1927) Z. anorg. Chem., 166, 213-8.
- Halberstadt.
(1884) Ber., 17, 2965.
- Hall, R. E., Robb, J. A. and Coleman, C. E.
(1926) J. Am. Chem. Soc., 48, 927-38.
- Halla, F.
(1935) Z. physik. Chem., 175, 63-82, 396-9.
(1936) Z. anorg. Chem., 226, 139-40.
- Haller, H. L. and Lynch, D. F. J.
(1924) Ind. Eng. Chem., 16, 273.
- Halpern, E.
(1926) Rosz. Chem., 6, 661-77.
- Hamai, S.
(1935) Bull. Chem. Soc. (Japan), 10, 5-16, 207-11.
- Hamberg.
(1885) J. prakt. Chem., [2], 33, 433.
- Hamberger, Anna.
(1906) Z. anorg. Chem., 50, 427.
- Hamburger, E.
(1911) Arch. ges. Physiol. (Pfluger's), 143, 187.

AUTHOR INDEX

- Hamid, M. Abdul.**
(1926) J. Chem. Soc., 129, 199-214.
- Hamid, M. Abdul and D'as Ras.**
(1930) J. Indian Chem. Soc., 7, 881.
- Hammarsten, Greta.**
(1929) C. r. trav. lab. Carlsberg, 17, No. 11.
- von Hammel, A.**
(1915) Z. physik. Chem., 90, 121.
- Hammick, D. L., Cousins, W. and Langford, E.**
(1928) J. Chem. Soc. (Lond.), 797.
- Hammick, D. L. and Currie, J. A.**
(1925) J. Chem. Soc., 127, 1623-8.
- Hammick, D. L., Goadby, H. K., and Booth, H.**
(1920) J. Chem. Soc., 117, 1589-92.
- Hammick, D. L. and Holt, S. E.**
(1926) J. Chem. Soc., 129, 1995-2003
(1927) J. Chem. Soc. (Lond.), 130, 493-7.
- Hammick, D. L. and Howard, J.**
(1932) J. Chem. Soc. (Lond.), 2915.
- Hammick, D. L. and Mullaby.**
(1921) J. Chem. Soc., 119, 1802-6.
- Hammick, D. L. and Zvegintzov, M.**
(1928) J. Chem. Soc. (Lond.), 1785-91.
(1930) J. Chem. Soc. (Lond.), 273-7.
- Hampshire, C. H. and Pratt, W. R.**
(1913) Pharm. Jour. (Lond.), 91, 140.
- Handy and Hoyt.**
(1927) J. Am. Pharm. Assoc., 16, 7.
- Hansen, H.**
(1930) Z. anorg. Chem., 186, 41.
- Hansen, L. A. and Williams, J. W.**
(1930) J. Am. Chem. Soc., 52, 2759.
- Hantzsch, A.**
(1902) Chem. Zentrbl., 11, 922.
- Hantzsch, A. and Seibalt, F.**
(1899) Z. physik. Chem., 30, 258-99.
- Hantzsch, A. and Vagt, A.**
(1901) Z. physik. Chem., 38, 705-42.
- Harkins, W. D.**
(1911) J. Am. Chem. Soc., 33, 1807-27.
- Harkins, W. D. and Clark, Geo. L.**
(1915) J. Am. Chem. Soc., 37, 1816.
- Harkins, W. D. and Paine, H. M.**
(1916) J. Am. Chem. Soc., 38, 2709.
(1919) J. Am. Chem. Soc., 41, 1155-68.
- Harkins, W. D. and Pearce, W. T.**
(1916) J. Am. Chem. Soc., 38, 2694, 2717.
- Harkins, W. D. and Winninchoff, W. J.**
(1911) J. Am. Chem. Soc., 33, 1827-36.
- Harman, R. W.**
(1927) J. Phys. Chem., 31, 511-8.
- Harpuder, K.**
(1923) Klin. Wochschr., 2, 1268.
(1924) Biochem. Z., 148, 354-60.
- Harrass, Paul.**
(1903) Arch. Internat. Pharmacodyamie et Therapie, 11, 431-63.
- Harris, I. W. H.**
(1932) J. Chem. Soc. (Lond.), 582-5, 1694-7, 2709-13.
- Harris, S. E. and Christiansen, W. G.**
(1934) J. Am. Pharm. Assoc., 23, 563-5.
- Hart, E. and Huselton, H. B.**
(1914) J. Am. Chem. Soc., 36, 2082-4.
- Hartley, G. S.**
(1931) Trans. Faraday Soc., 27, 10-29.
- Hartley, H.**
(1908) J. Chem. Soc. (Lond.), 93, 741-5.
- Hartley, H. and Barrett, W. H.**
(1909) J. Chem. Soc. (Lond.), 95, 1178-85.
- Hartley, H., Drugman, J., Vlieland, C. A., and Bourdillon, Robt.**
(1913) J. Chem. Soc. (Lond.), 103, 1749.
- Hartley, H., Jones, B. M. and Hutchinson, G. A.**
(1908) J. Chem. Soc. (Lond.), 93, 825.
- Hartley, H. and Thomas.**
(1906) J. Chem. Soc. (Lond.), 89, 1028.
- Hartshorn, N. H.**
(1927) J. Chem. Soc. (Lond.), 1759-68.
- Haslam.**
(1886) Chem. News., 53, 87.
- Haslam, R. T., Calingaert, G. and Taylor, C. M.**
(1924) J. Am. Chem. Soc., 46, 308.
- Haslam, R. T., Whitman, W. C. and Cochran, J. D., Jr.**
(1924) J. Proc. Nat. Lime Assoc., 6th, Ann. Conv., 53-62.
(1924) Bull. Mass. Inst. Techn., 60, No. 52.
- Hasselblatt, M.**
(1921) Z. anorg. allgem. Chem., 119, 313-24.

AUTHOR INDEX

- Hastings, A. B., Murray, C. D. and Sendroy, J. Jr.**
(1927) *J. Biol. Chem.*, **71**, 723-781.
- v. Hauer.**
(1858) *J. prakt. Chem.*, **74**, 433.
- Haupt, W.**
(1914) *Z. angew. Chem.*, **27**, 535-6.
- Hauser, O.**
(1905) *Z. anorg. Chem.*, **45**, 194.
(1907) *Z. anorg. Chem.*, **54**, 196-212.
- Hauser, O. and Herzfeld.**
(1912) "Die Seltenen Erden and Erdsäuren". p. 61.
(Ferdinand Enke, Stuttgart)
- Hauser, O. and Wirth, F.**
(1908) *Z. anal. Chem.*, **47**, 389.
(1909) *J. prakt. Chem.*, [2], **79**, 358-68.
(1909a) *Z. angew. Chem.*, **22**, 484.
(1912) *Z. anorg. Chem.*, **78**, 75-94.
- Hauslick, R. S.**
(1935) Dissertation, Columbia Univ. N. Y.
- Hawkins, F. S. and Partington, J. R.**
(1928) *Trans. Faraday Soc.*, **24**, 518-30.
(1930) *Trans. Faraday Soc.*, **26**, 78-86.
- Hawkins, J. A. and Schilling, C. W.**
(1936) *J. Biol. Chem.*, **113**, 273-8, 649-53.
- Hayami, R.**
(1921) *J. Chem. Soc. Japan*, **42**, 421-44.
(1921) *Mem. Coll. Sci. Kyoto, Imp. Univ.*, **4**, 359-69.
- Heath, W. P.**
(1915) Privately Printed, Atlanta, Ga.
- Hecht,**
(1882) *Ann. (Liebigs)*, **213**, 72.
- Hehner, O. and Mitchell, C. A.**
(1897) *J. Am. Chem. Soc.*, **19**, 40.
- van der Heide.**
(1893) *Z. physik. Chem.*, **12**, 418.
- Heidenhain, H.**
(1918) *Ind. Eng. Chem.*, **10**, 426-9.
- Hein, Fr. and Daniel, W.**
(1937) *Z. anorg. Chem.*, **234**, 155-60.
- Heise, G. W.**
(1912) *J. Phys. Chem.*, **16**, 373.
- Helberg, H.**
(1925) *Ann. chim.*, [10], **4**, 121.
- Helff, A.**
(1893) *Z. physik. Chem.*, **12**, 217.
- Hellwig.**
(1900) *Z. anorg. Chem.*, **25**, 166-83.
- Hempel, W.**
(1901) *Z. angew. Chem.*, **14**, 865.
- Hempel, W. and Tedesco, H.**
(1911) *Z. angew. Chem.*, **24**, 2469.
- Henderson, W. N. and Taylor, H. S.**
(1916) *J. Phys. Chem.*, **20**, 670.
- Hendricks, S. B.**
(1926) *J. Phys. Chem.*, **30**, 248-53.
- Hendrixon, W. S.**
(1897) *Z. anorg. Chem.*, **13**, 73.
(1920) *J. Am. Chem. Soc.*, **42**, 724-7.
- Henkel, H.**
(1905) Dissertation, Berlin.
(1912) Landolt & Bornstein's, "Tabellen," 4th Ed., 602.
- Henry.**
(1884) *Compt. rend.*, **99**, 1157.
- Henstock, H.**
(1934) *J. Chem. Soc. (Lond.)*, 1340-3.
- Hering, E.**
(1925-27) *Revista Caliche, Chili*.
(1926) These, Univ. Strasbourg.
- Hering, H.**
(1936) These, Paris.
(1936) *Ann. chim.*, [11], **5**, 483-586.
- Hermans, P. H.**
(1925) *Z. anorg. allgem. Chem.*, **142**, 111-4.
- Herold, J.**
(1905) *Z. Elektrochem*, **11**, 417.
- Herrero, G.**
(1931) *Anales, soc. Esp. fis. quim.*, **29**, 616-20.
(1932) *Anales soc. Esp. fis. quim.*, **30**, 880-5.
(1933) *Anales soc. Esp. fis. quim.*, **31**, 5-10, 416-21.
(1936) *Anales, soc. Esp. fis. quim.*, **34**, 549-52.
- Herrmann, Gottfried.**
(1911) *Z. anorg. Chem.*, **71**, 257-302.

AUTHOR INDEX

Hertel, E.

- (1932) Z. physik. Chem., (B), 15, 56.
- (1932) Ann. (Liebigs), 499, 136.

Herz, W.

- (1898) Ber., 31, 2671.
- (1900) Z. anorg. Chem., 25, 155.
- (1901) Z. anorg. Chem., 28, 475.
- (1902) Z. anorg. Chem., 30, 281.
- (1903) Z. anorg. Chem., 33, 355.
- (1905) Dissertation (Berlin).
- (1910) Z. anorg. Chem., 68, 69, 165.
- (1910a) Z. anorg. Chem., 66, 93, 358.
- (1910b) Z. anorg. Chem., 65, 341-4.
- (1910c) Z. anorg. Chem., 67, 365.
- (1911) Z. anorg. Chem., 70, 70, 170.
- (1911a) Z. anorg. Chem., 71, 206.
- (1911b) Z. anorg. Chem., 72, 106.
- (1911-12) Z. anorg. Chem., 73, 274.
- (1917) Z. Elektrochem., 23, 23-4.

Herz, W. and Anders, G.

- (1907) Z. anorg. Chem., 52, 164-72, 271-8.

Herz, W. and Bulla, A.

- (1909) Z. anorg. Chem., 63, 282-4.
- (1911) Z. anorg. Chem., 71, 255.

Herz, W. and Fischer, H.

- (1904) Ber., 37, 4747.
- (1905) Ber., 38, 1140.

Herz, W. and Hellebrandt, Marie.

- (1923) Z. anorg. allgem. Chem., 130, 188-9.

Herz, W. and Hiebenthal, F.

- (1928) Z. anorg. Chem., 177, 368-80.

Herz, W. and Knoch.

- (1904) Z. anorg. Chem., 41, 319.
- (1905) Z. anorg. Chem., 45, 263-8.

Herz, W. and Kuhn, F.

- (1908) Z. anorg. Chem., 58, 159-67.
- (1908) Z. anorg. Chem., 60, 152-62.

Herz, W. and Kurzer, A.

- (1910) Z. Elektrochem., 16, 240, 869.

Herz, W. and Lewy.

- (1905) Z. Elektrochem., 11, 818.

Herz, W. and Lorentz, E.

- (1929) Z. physik. Chem. (A), 140, 406, 420.

Herz, W. and Martin, Edith.

- (1924) Z. anorg. allgem. Chem., 140, 339-40.

Herz, W. and Muhs, G.

- (1903) Ber., 36, 3717.

Herz, W. and Paul, W.

- (1913) Z. anorg. Chem., 82, 431.
- (1914) Z. anorg. Chem., 85, 214.

Herz, W. and Rathmann, W.

- (1913) Z. Elektrochem., 19, 553, 887.

Herzfeld.

- (1892) Z. Ver. Zuckerind., 181.
- (1897) Z. Ver. Zuckerind., 34, 820.

von Hevesy, Geo.

- (1900) Z. physik. Chem., 73, 537.
- (1909) Z. Elektrochem., 15, 529.
- (1911) Phys. Ztschr., 12, 1214.
- (1912) J. Phys. Chem., 16, 429.
- (1923) Chem. and Ind., 42, 929.
- (1925) K. Danske, Videnska. Selskah. Mat. fys. Medd., 6, No. 7, 1-149.

von Hevesy, G., Christiansen, J. A. and Berglund, V.

- (1925) Z. anorg. allgem. Chem., 144, 69-74.

von Hevesy, G. and Kimura, K.

- (1925) J. Am. Chem. Soc., 47, 2540.
- (1925) Z. angew. Chem., 38, 775.

von Hevesy, G. and Rona, E.

- (1915) Z. physik. Chem., 89, 303.

von Hevesy, G. and Wagner, O. H.

- (1930) Z. anorg. Chem., 191, 194-200.

Heyl, F. W. and Greer, F. E.

- (1922) Am. J. Pharm., 94, 80.

Heyrovsky, J. and Berezicky, S.

- (1929) Coll. Czechoslovak. Chem. Com., 1, 19-46.

Hicks, W. B.

- (1915) J. Am. Chem. Soc., 37, 844.

Hildebrand, J. H.

- (1917) J. Am. Chem. Soc., 39, 2297.
- (1937) J. Am. Chem. Soc., 56, 2033-5.

Hildebrand, J. H. and Buehrer, T. F.

- (1920) J. Am. Chem. Soc., 42, 2213-8.

Hildebrand, J. H., Ellefson, E. T. and Beebe, C. W.

- (1917) J. Am. Chem. Soc., 39, 2302.

Hildebrand, J. H. and Jenks, C. A.

- (1920) J. Am. Chem. Soc., 42, 2180-9.
- (1921) J. Am. Chem. Soc., 43, 2172-7.

AUTHOR INDEX

- Hildebrand, J. H. and Negishi, G. R.
(1937) J. Am. Chem. Soc., 56, 339-41.
- Hill, A. E.
(1908) J. Am. Chem. Soc., 30, 68-74.
(1917) J. Am. Chem. Soc., 39, 218-31.
(1921) J. Am. Chem. Soc., 43, 263.
(1928) J. Am. Chem. Soc., 50, 2678-92.
(1930) J. Am. Chem. Soc., 52, 3813-7.
(1930a) J. Am. Chem. Soc., 52, 3817-25.
(1934) J. Am. Chem. Soc., 56, 1071-8.
(1937) J. Am. Chem. Soc., 59, 2242-4.
- Hill, A. E. and Bacon, L. R.
(1927) J. Am. Chem. Soc., 49, 2487-95.
- Hill, A. E. and Brown, S. F.
(1931) J. Am. Chem. Soc., 53, 4316-20.
- Hill, A. E. and Distler, E. F.
(1935) J. Am. Chem. Soc., 57, 2203-4.
- Hill, A. E. and Donovan, J. E.
(1931) J. Am. Chem. Soc., 53, 934-41.
- Hill, A. E. and Hill, D. G.
(1927) J. Am. Chem. Soc., 49, 967-9.
- Hill, A. E. and Kaplan, N.
(1936) J. Am. Chem. Soc., 58, 1644-5.
(1938) J. Am. Chem. Soc., 60, 550-4.
- Hill, A. E. and Loucks, C. M.
(1937) J. Am. Chem. Soc., 59, 2094-98.
- Hill, A. E. and Miller, F. W., Jr.
(1925) J. Am. Chem. Soc., 47, 2702-12.
(1927) J. Am. Chem. Soc., 49, 669-86.
- Hill, A. E. and Moskowitz, S.
(1929) J. Am. Chem. Soc., 51, 2396-8.
(1931) J. Am. Chem. Soc., 53, 941-6.
- Hill, A. E. and Ricci, J. E.
(1931) J. Am. Chem. Soc., 53, 4305-15.
- Hill, A. E. and Simmons, J. D.
(1909) J. Am. Chem. Soc., 31, 821-39.
(1909) Z. physik. Chem., 67, 594-617.
- Hill, A. E. and Smith, S. B.
(1929) J. Am. Chem. Soc., 51, 1625-36.
- Hill, A. E. and Taylor, W. J. Jr.
(1938) J. Am. Chem. Soc., 60, 1099-1104.
- Hill, A. E. and Wills, J. H.
(1938) J. Am. Chem. Soc., 60, 1647-55.
- Hill, A. E., Willson, H. S. and Bishop, J. A.
(1933) J. Am. Chem. Soc., 55, 520-6.
- Hill, A. E. and Yanick, N. S.
(1935) J. Am. Chem. Soc., 57, 645-51.
- Hill, A. E. and Zink, W. A. H.
(1909) J. Am. Chem. Soc., 31, 44.
- Hill, C. A. and Cocking, T. T.
(1912) Pharm. Jour. (Lond.), 89, 155.
- Hilpert, S.
(1916) Z. angew. Chem., 29, I, 57-9.
(1916) Chem. Abs., I 0, 1924.
- Hinrichsen, F. W. and Sachsels, E.
(1904-05) Z. physik. Chem., 50, 81-99.
- Hiral, M.
(1926) Bull. Chem. Soc. (Japan), I, 123-5.
- Hissink, D. J.
(1900) Z. physik. Chem., 32, 557.
- Hitchcock, F. R. M.
(1895) J. Am. Chem. Soc., 17, 529.
- Hoermann, Fritz.
(1929) Z. anorg. Chem., 177, 145-86.
- van't Hoff, J. H.
(1901) Sitzber. k. Akad. Wiss. (Berlin), p. 1035.
(1905) Z. anorg. Chem., 47, 247.
(1912) "Untersuchungen über die Bildungsverhältnisse der Ozeanischen Salzablagerungen, insbesondere des Staasfurter Salzlagere." von J. H. van't Hoff et al Herausgegeben von H. Precht & E. Cohn. (Liepzig, 1912).
- van't Hoff, J. H. and Goldschmidt, H.
(1895) Z. physik. Chem., 17, 508.
- van't Hoff, J. H. and Meyerhoffer, W.
(1898) Z. physik. Chem., 27, 75.
(1899) Z. physik. Chem., 30, 64-88.
- van't Hoff, J. H. and Kenrick, F. B.
(1912) "Ozeanischen Salzablagerungen," pp. 37-40.
- Hoffert, N. li.
(1922) J. Soc. Chem. Ind., 41, 334.
- Hofmann.
(1927) N. Jahrb. Min Beilg., 55, A, 149.
- Hofmann, K. A., Höbold, K. and Quoos.
(1911-12) Liebig's Ann., 386, 304-17.
- Hofmann, K. A. and Höbold, K.
(1911) Ber. 44, 1776.
- Hofmann, K. A., Kirmireuther, K. and Thal, A.
(1910) Ber., 43, 183.

AUTHOR INDEX

- Hogg, A. R.**
(1926) J.Chem.Soc., 129, 855-62.
- Hoitsema, C.**
(1895) Z.physik.Chem., 17, 651.
(1898) Rec.trav.chim., 17, 310.
(1898a) Z.physik.Chem., 27, 315.
- Holde, D. and Selim, M.**
(1925) Ber., 588, 523-8.
- Holde, D. and Takehara, K.**
(1925) Ber., 588, 1788-91.
- Hollemann, H. and Kleese, W.**
(1938) Z.anorg.Chem., 237, 172-6.
- Holmes, J.**
(1918) J.Chem.Soc., 113, 263-75.
- Holmes, W. C.**
(1920) Ind.Eng.Chem., 12, 781-3.
- Holmes, W. C., Hutchinson, G. F. and Zieber, B.**
(1931) Ind.Eng.Chem., 23, 1102-4.
- Holland, A.**
(1897) Ann.chim.anal., 2, 243.
- Holland, H. C.**
(1930) J.Chem.Soc. (Lond.), 643-8.
- Holleman, A. F.**
(1893) Z.physik.Chem., 12, 135.
(1896) Rec.trav.chim., 15, 159.
- Hollemann, Kohlrausch and Rose.**
(1893) Z.physik.Chem., 12, 129, 241.
- Holleman, R.**
(1903) Z.physik.Chem., 43, 129-59.
(1905-06) Z.physik.Chem., 54, 98-110.
- Holluta, J. and Mautner, S.**
(1927) Z.physik.Chem., 127, 455-75.
- Holluta, J. and Peter, F.**
(1929) Z.physik.Chem., 143, (A), 119-34
- Holmberg, O.**
(1907) Z.anorg.Chem., 53, 83-134.
- Holt, L. Emmett, Jr.**
(1925) J.Biol.Chem., 66, 23-8.
- Holt, L. E., Jr., Le Mer, V. K. and Chown, H. B.**
(1925) J.Biol.Chem., 64, 509-89.
(1925) Proc.Soc.Exp.Biol.Med., 22, 283-7.
- Höltje, R.**
(1929) Z.anorg.Chem., 181, 395.
- Holty, J. G.**
(1905) J.Phys.Chem., 9, 764.
- Hölzl, F.**
(1931) Monatshefte Chem., 58, 29-46, 249.
(1937) Z.Elektrochem., 43, 302-4.
- Hölzl, F. and Crotofino, H.**
(1927) Z.anorg.Chem., 159, 78-86.
- Homfray, I. F.**
(1910) J.Chem.Soc. (Lond.), 97, 1669.
- Hönigschmid, O. and Stribel, H.**
(1930) Z.anorg.Chem., 194, 295.
- Horiuti, J.**
(1928) Bull. Inst.Phys.Chem.Res., 7, 131.
(1931-32) Sci.Papers Inst.Phys.Chem. Res. (Tokoyo), 17, 125-264.
- Horn, D. W.**
(1907) Am.Chem.Jour., 37, 471.
- Horn, D. W. and Van Wagener.**
(1903) Am.Chem.Jour., 30, 347.
- Houston, D. F.**
(1936) J.Res.U.S.Bureau of Standards, 17, 55-8.
- Houston and Trichborne.**
(1890) Brit.Med.Jour., 1063.
- Howard, D. H., Jr. and Bowne, A. W.**
(1934) J.Am.Chem.Soc., 56, 2348-57.
- Howard, D. H. Jr., Friederich, F. and Browne, A. W.**
(1934) J.Am.Chem.Soc., 56, 2332-40.
- Howe, Jas. L.**
(1894) J.Am.Chem.Soc., 16, 388.
- Howells, W. J.**
(1929) J.Chem.Soc. (Lond.), 910-5
(1930) J.Chem.Soc. (Lond.), 2010-6
(1931) J.Chem.Soc. (Lond.), 3208-12.
- Huber, H.**
(1921) Z.anorg.allgem.Chem., 116, 139.
- Hudson, J. C.**
(1925) J.Chem.Soc., 127, 1332-47.
- Huecke.**
(1884) J.prakt.Chem., [2], 29, 49.
- Hüfner, G.**
(1895) Archiv.anat.u.physiol., 209-12.
(1906-07) Z.physik.Chem., 57, 615-22.
(1907) Z.physik.Chem., 59, 416.

AUTHOR INDEX

- Hüfner, G. and Kulz.
(1895) J. prakt. Chem., 28, 256.
- Hughes, O. L. and Mead, T. H.
(1929) J. Chem. Soc. (Lond.), 2282-4.
- Hulett, G. A.
(1901) Z. physik. Chem., 37, 406.
(1904) Trans. Am. Electrochem. Soc., 6, 109.
- Hulett, G. A. and Allen, L. E.
(1902) J. Am. Chem. Soc., 24, 674.
- Hülsmann, O. and Biltz, Wm.
(1934) Z. anorg. Chem., 218, 369-78.
- Hume-Rothery.
(1928) J. Chem. Soc. (Lond.), 131, 947-62.
- Hunt.
(1870) Am. Jour. Sci., [2], 40, 154.
- Hunt, H.
(1932) J. Am. Chem. Soc., 54, 3509-12.
- Hunt, H. and Boncyk, L.
(1933) J. Am. Chem. Soc., 55, 3528-30.
- Husain, S.
(1929) Z. anorg. Chem., 177, 215.
- Hüttig, Gustav, F.
(1914) Z. physik. Chem., 87, 144.
- Hüttig, G. F. and Pohle, F.
(1924) Z. anorg. allgem. Chem., 138, 14.
- Hüttig, G. F. and Renschler, F.
(1924) Z. anorg. Chem., 137, 155-80.
- Hüttig, G. F. and Steudemann, W.
(1927) Z. physik. Chem., 126, 105-17.
- Huybrechts, M. and Andrault de Langeron, M.
(1930) Bull. soc. chim. (Belg.), 39, 43-57.
- Huybrechts, M. and Degard, Ch.
(1933) Bull. soc. chim. (Belg.), 42, 331-46.
- Huybrechts, M. and Ramelot, H.
(1926) Bull. soc. chim. Belg., 35, 239-60.
- Hyrnakowski, Kand Adamanis, F.
(1934) Roczniki chem., 14, 194.
- Igelsrud, I. and Thompson, T. G.
(1936) J. Am. Chem. Soc., 58, 318-22.
(1936a) J. Am. Chem. Soc., 58, 2003-9.
- Iitsuka, D.
(1919) Mem. Coll. Sci. Kyoto, Imp. Univ., 4, 61-4.
- Iljinsky, V. P.
(1924) J. Russ. Phys. Chem. Soc., 54, 29-60.
- Iljinsky, V. P. and Sagaidotschuy, A. F.
(1931) Zhur. Obs. Khimii, 1, 584.
- Illingworth, B. and Howard, A.
(1884) Phil. Mag., [5], 18, 124.
- Imatsu, A.
(1911-12) Mem. Col. Sci. Eng. (Kyoto), 3, 257-63.
- Imre, L.
(1927) Z. anorg. Chem., 164, 214.
(1927) Z. anorg. Chem., 166, 1-15.
- Inamura, K.
(1919) Mem. Coll. Sci., Kyoto, Imp. Univ., 3, 105-12.
- Ingham, J. W.
(1928) J. Chem. Soc., (Lond.), 131, 1917-30.
- Inglis, J. K. H.
(1903) J. Chem. Soc. (Lond.), 83, 1010.
- Inouye, R.
(1925) Mem. Coll. Sci., Kyoto, Imp. Univ. (A), 8, 287-90.
- Ionescu, V. and Slusanschi, H.
(1933) Bull. Soc. Chim. (France), [4], 53, 1087-96.
- Ipatiew, W. W., Drushina-Artemowitsch, S. I. and Tichomirow, W. I.
(1931) Zhur. Obs. Khimii, 1, 594-7.
(1932) Ber., 65, 568-71.
- Ipatiew, W. W. and Theodorowitch, W. P.
(1932) Zhur. Obs. Khimii, 2, 305-10.
(1934) Zhur. Obs. Khimii, 4, 395-9.
- Irvin, N. N. and Russell, A. S.
(1932) J. Chem. Soc., (Lond.), 891-7.
- Irving and Young.
(1888) J. Chem. Soc. (Lond.), 56, 344.
- Irving, L.
(1926) J. Biol. Chem., 68, 239, 513.
- Isaac, Florence.
(1908) J. Chem. Soc. (Lond.), 93, 398, 927.
- Isbekow, W.
(1913) Z. anorg. Chem., 84, 24.
(1925) Z. anorg. allgem. Chem., 143, 80-8.
- Ishikawa, T.
(1926) Bull. Chem. Soc. Japan, 1, 139-42.
- Ishikawa, F. and Hagisawa, H.
(1931) Bull. Inst. Phys. Chem. Res. (Tokyo), 10, 10.

AUTHOR INDEX

- Ishikawa, F. and Murooka, T.
 (1928) Bull. Inst. Phys. Chem. Res.
 (Tokyo), 7, 1167.
 (1929) Bull. Inst. Phys. Chem. Res.
 (Tokyo), 8, 77.
 (1933) Sci. Reports Tohoku Univ. (1)
 22, 201, 220, 235.
- Ishikawa, F. and Oku, M.
 (1927) Bull. Inst. Chem. Res. (Tokyo), 6,
 80.
- Ishikawa, F. and Shibata, E.
 (1932) Sci. Reports Tohoku Univ. (1)
 21, 507.
- Ishikawa, F. and Ueda, Y.
 (1930) J. Chem. Soc. (Japan), 51, 634.
 (1933) Sci. Reports Tohoku Univ. (1)
 22, 270.
- Ishikawa, F. and Yoshida, T.
 (1930) Bull. Inst. Phys. Chem. Res.
 (Tokyo), 9, 12.
- van Itallie, E. J.
 (1908) Z. anorg. Chem., 60, 358-65.
- Iwaki, J.
 (1914) Mem. Col. Sci. (Kyoto), 1, 81-8.
- Iwase, E.
 (1930) Bull. Inst. Phys. Chem. Res.
 (Tokyo), 9, 542.
- Iwig and Hecht.
 (1886) Liebig's Ann., 233, 167.
- Jacek, W.
 (1915) Bull. intern. acad. sci. Cracovie
 (A), 26-43.
 (1926) Roczn. Chem., 6, 501-9.
- Jackman, D. N. and Browne, A.
 (1922) J. Chem. Soc., 121, 694-7.
- Jackson, K. S. and Rienacker, G.
 (1930) J. Chem. Soc. (Lond.), 1687.
- Jackson, R. F.
 (1914) J. Am. Chem. Soc., 36, 2350.
 (1914) Bull. Bureau Standards, 2, 331-45.
- Jackson, R. F. and Silsbee, C. G.
 (1925) Chem. Abs., 16, 3022.
- Jacobs, W.
 (1917) Chem. Weekblad., 14, 208-12.
- Jacobson, C. A. and Holmes, A.
 (1916) J. Biol. Chem., 25, 29-53.
- Jaeger, A.
 (1901) Z. anorg. Chem., 27, 25, 33.
- Jaeger, F. M. and Blumendal, H. B.
 (1928) Z. anorg. Chem., 175, 194, 211.
- Jaeger, F. M. and Doornbosch, H. J. D.
 (1912) Z. anorg. Chem., 75, 261.
- Jaeger, F. M. and Germs, H. C.
 (1921) Z. anorg. allgem. Chem., 119,
 145-73.
- Jaeger, F. M. and van Klooster, H. S.
 (1912) Z. anorg. Chem., 78, 245.
- Jaeger, F. M. and Menke, J. B.
 (1912) Z. anorg. Chem., 75, 241-260.
 (1912) Proc. k. Akad. Wet. (Amst.),
 14, 724.
- Jaeger, F. M. and Thomas, W.
 (1918) Verslag. Akad. wetenschappen
 (Amsterdam), 27, 675.
 (1919) Proc. Acad. Sci., Amsterdam,
 21, 693-706.
 (1919) Rec. trav. chim., 38, 249.
- Jahn-Held, W. and Jellinke, K.
 (1936) Z. Elektrochem., 42, 608-11.
- Jaisle.
 (1926) Dissertation, Stuttgart.
- Jakowkin, A. A.
 (1895) Z. physik. Chem., 18, 588.
 (1896) Z. physik. Chem., 20, 38.
 (1899) Z. physik. Chem., 29, 630.
- Jakowkin, A. A. and Archangelsky, P. A.
 (1936) Z. anorg. Chem., 226, 350-2.
- James, C., Fogg, H. C., McIntire, B. W.,
 Evans, R. H. and Donovan, J. S.
 (1927) J. Am. Chem. Soc., 49, 132.
- James, C. and Holden, H. C.
 (1913) J. Am. Chem. Soc., 35, 559.
- James, C. and Pratt, L. A.
 (1910) J. Am. Chem. Soc., 32, 873.
- James, C. and Robinson, J. E.
 (1913) J. Am. Chem. Soc., 35, 754.
- James, C. and Whittmore, C. F.
 (1912) J. Am. Chem. Soc., 34, 1168.
- James, C., Whittmore, C. F. and
 Holden, H. C.
 (1914) J. Am. Chem. Soc., 36, 1854.
- James, C. and Willand, P. S.
 (1916) J. Am. Chem. Soc., 38, 1499.
- Jander, G. and Ruppolt, W.
 (1937) Z. physik. Chem. (A), 179, 43-50.

AUTHOR INDEX

- Jander, G. and Wickert, K.**
(1936) Z. physik. Chem., 178, 63.
- Janecke, E.**
(1908) Z. physik. Chem., 64, 343.
(1912) Z. physik. Chem., 80, 1.
(1917) Z. anorg. allgem. Chem., 100, 161-236.
(1918) Z. anorg. allgem. Chem., 102, 41-65.
(1918) Z. anorg. allgem. Chem., 103, 1-54.
(1923) Rec. trav. chim., 42, 740-4.
(1927) Z. physik. Chem., 127, 71-92.
(1928) Z. angew. Chem., 41, 916-24.
(1929) Z. angew. Chem., 42, 1169-72.
(1929) Z. Elektrochem., 35, 332-4.
(1929a) Z. Elektrochem., 35, 716-27.
(1930) Z. Elektrochem., 36, 645-54.
(1930) Z. anorg. Chem., 188, 72-85.
(1932) Rec. trav. chim., 51, 579-84.
(1933) Z. anorg. Chem., 213, 149.
(1933a) Z. Elektrochem., 39, 682-86.
(1936) Z. physik. Chem., 177, 7-16.
(1937) Z. Elektrochem., 43, 924.
(1938) Z. Elektrochem., 44, 183-93.
- Jänecke, E., Eissner, W. and Brill, R.**
(1927) Z. anorg. Chem., 160, 171-184.
- Jänecke, E. Hamacher, H. and Rahlfs, E.**
(1932) Z. anorg. Chem., 206, 357-68.
- Jänecke, E. and Hoffmann, A.**
(1932) Z. Elektrochem., 38, 880.
- Jänecke, E. and Mühlhauser, W.**
(1936) Z. anorg. Chem., 228, 241-8.
- Janecke, E. and Rahlfs, E.**
(1930) Z. Elektrochem., 36, 648.
(1932) Z. Elektrochem., 38, 9-12.
- Janickis, J.**
(1932) Z. anorg. Chem., 205, 49-75.
(1934) Z. anorg. Chem., 218, 89-103.
- Janickis, J. and Gutmanaitis, H.**
(1936) Z. anorg. Chem., 227, 1-16.
- Jantsch, G.**
(1912) Z. anorg. Chem., 76, 321.
(1926) Z. anorg. allgem. Chem., 153, 9-16.
- Jantsch, G. and Grünkraut, A.**
(1912-13) Z. anorg. Chem., 79, 309-21.
- Jaques, A.**
(1910) Trans. Faraday Soc., 5, 235.
- Jarry, R.**
(1897) Compt. rend., 124, 288-91.
(1899) Ann. chim. phys., [7], 17, 342.
- Jatlov, V. S. and Poljakova, E. M.**
(1938) Zhur. Obs. Khimii, 8, 774-6.
- Jatlov, V. S. and Pinaevskaja, E. N.**
(1938) Zhur. Obs. Khimii, 8, 1665-9.
- Jegorow, W. S.**
(1931) Chem. Jour. (Russ.), A, 1, 1266.
- Jehn, D. B. and Huddleston, L. J.**
(1924) J. Chem. Soc., 125, 1451-6.
- Jellinek, K.**
(1911) Z. anorg. Chem., 70, 86-134.
- Jellinek, K. and Czerwinski.**
(1922) Z. physik. Chem., 102, 438.
- Jellinek, K. and Gordon, H.**
(1924) Z. physik. Chem., 112, 247.
- Jellinek, K. and Kühn, W.**
(1923) Z. physik. Chem., 105, 340.
- Jelissejew, A. G.**
(1926) Ber. Inst. Phys. Chem. Analyse (Leningrad), 3, 443.
- Jensen, K. A.**
(1934) Z. anorg. Chem., 219, 238-42.
- Jencic, S.**
(1934) Arhiv. Hemiju Formicyn, 8, 62-6.
- Jirsa, F. and Buryanek, O.**
(1923) Z. Elektrochem., 29, 129.
- Jirsa, F. and Jelinek, H.**
(1924) Z. Elektrochem., 30, 286, 534.
- Jo, Inohiko.**
(1911) Mem. coll. sci. Eng. (Kyoto), 3, 41-9, 212.
(1912) Tokyo Chem. Soc., 33, No. 7, July.
- Joannis, A.**
(1882) Ann. chim. phys., [5], 26, 489.
(1906) Ann. chim. phys., [8], 7, 41.
- Johns, L. B., Petersqn, W. D. and Hixon, R. M.**
(1930) J. Phys. Chem., 34, 2218.
- Johnson.**
(1886) Chem. News., 54, 75.
- Johnson, C. R. and Hulett, G. A.**
(1933) J. Am. Chem. Soc., 55, 2258-62.
- Johnson, C. R. and Low, Geo. W. Jr.**
(1933) J. Am. Chem. Soc., 55, 2262-5.

AUTHOR INDEX

- Johnson, W. C. and Krumboltz, O. F.**
(1933) Z. physik. Chem. (A), 167, 249-59.
- Johnson, W. C. and Piskur, M. M.**
(1933) J. Phys. Chem., 37, 93-9.
- Johnson, W. C. and Wheatley, A. C.**
(1934) Z. anorg. Chem., 216, 273.
- Johnston, H. L., Cuta, Frantisck and Garrett, A. B.**
(1933) J. Am. Chem. Soc., 55, 2311-25.
- Johnston, H. L. and Leland, H. L.**
(1938) J. Am. Chem. Soc., 60, 1439-45.
- Johnston, J.**
(1915) J. Am. Chem. Soc., 37, 2001-20.
(1916) J. Am. Chem. Soc., 38, 947-75.
- Johnston, J. and Grove, C.**
(1931) J. Am. Chem. Soc., 53, 3976-91.
- Johnston, J. and Williamson, E. D.**
(1916) J. Am. Chem. Soc., 38, 975-83.
- Johnstone, A. F. and Leppla, P. W.**
(1934) J. Am. Chem. Soc., 56, 2233-8.
- Jolin.**
(1889) Arch. anat. u. physiol., 262.
- Jones, B. M.**
(1908) J. Chem. Soc. (Lond.), 93, 1744.
- Jones, F. E., Hamer, W. E., Davies, C. W. and Bury, C. R.**
(1930) J. Phys. Chem., 34, 564.
- Jones, G. and Baekström, S.**
(1934) J. Am. Chem. Soc., 56, 1517-23.
- Jones, G. and Hartmann, M. L.**
(1915) J. Am. Chem. Soc., 37, 241.
(1916) Trans. Am. Electrochem. Soc., 30, 295-325
- Jones, G. and Schumb, W. C.**
(1921) Proc. Am. Acad., 56, 199.
- Jones, H. C.**
(1907) Carnegie Publication No. 60, Washington, D. C.
- Jones, H. C. and Getman, F. H.**
(1904) Z. physik. Chem., 49, 419.
- Jones, W. J.**
(1911) J. Chem. Soc. (Lond.), 99, 392.
- de Jong, A. W. K.**
(1909) Rec. trav. chim., 28, 343.
(1912) Rec. trav. chim., 31, 256.
- Jonker, W. P. A.**
(1909) Z. anorg. Chem., 62, 84.
- Jordis, E.**
(1903) Ber., 36, 2542.
- Jørgensen.**
(1879) J. prakt. Chem., [2], 18, 205.
(1879) J. prakt. Chem., [2], 19, 49.
(1879) J. prakt. Chem., [2], 20, 195.
(1884) J. prakt. Chem., [2], 30, 1.
(1890) J. prakt. Chem., [2], 42, 208.
- Jordis, E.**
(1903) Ber., 36, 2542.
- Joseph, A. F.**
(1920) J. Chem. Soc., 117, 377-81.
- Joulin.**
(1873) Ann. chim. phys., [4], 30, 260.
- Jowett, M. and Price, H. I.**
(1932) Trans. Faraday Soc., 28, 668-81.
- Joyner, R. A.**
(1912) Z. anorg. Chem., 77, 108.
- Jucaitis, P.**
(1934) Z. anorg. Chem., 220, 257-67.
- Jungfleisch, E.**
(1912) Compt. rend., 155, 801.
- Jungfleisch, E. and Landrieu, Ph.**
(1914) Ann. chim., 2, 1-56, 333.
(1914a) Compt. rend., 158, 1306-11.
- Jürgens.**
(1885) Jahresber. Chem., 1722.
- Jurisch.**
(1912) Dissertation, Leipzig.
- Just, G.**
(1901) Z. physik. Chem., 37, 342-367.
- Justin-Mueller, E.**
(1918) Compt. rend., 167, 779.
- Kachtanow, L. I. and Obstchouk, O. N.**
(1937) Zhur. Obs. Khimii, 7, 839-41.
- Kagan and Kamyschau.**
(1932) Chim. Shurn. Ser. 8.
Shurn. prikaadnoi Chim., 5, 347.
- Kahlenberg, L. and Brewer, R. K.**
(1908) J. Phys. Chem., 12, 283-9.
- Kahlenberg, L. and Krauskopf, F. C.**
(1908) J. Am. Chem. Soc., 30, 1104-15.
- Kahlenberg, L. and Wittich, W. J.**
(1909) J. Phys. Chem., 13, 421-5.

AUTHOR INDEX

- Kahlukow, I. and Sachanow, A.
(1909) J. Russ. Phys. Chem. Soc., 41, 1755.
- Karandeeff, B.
(1909) Zentralbl. Min. Geol., p. 728.
(1910) Z. anorg. Chem., 68, 188.
- Karaoglanow, Z.
(1917) Z. anal. Chem., 56, 228.
- Karaoglanow, Z. and Sagortschev, V.
(1932) Z. anorg. Chem., 205, 270.
- Karantassis, Tryphon.
(1927) Ann. chim. [10], 8, 71-105.
- Karl, G.
(1910) Z. anorg. Chem., 68, 57.
- Karrer, P.
(1922) Ber., 55B, 2861.
- Karsten.
(1864-5) Ann. der Chem. u. Pharm. Suppl. Bd., 3, 170.
- Karsten, B. J.
(1907) Z. anorg. Chem., 53, 367.
- Kasarnowsky, J.
(1924) Z. physik. Chem., 109, 289.
- Katz, S. H. and James, C.
(1913) J. Am. Chem. Soc., 35, 872.
- Kaufmann, H. P.
(1935) Archiv. pharm., 273, 22-31.
- Kaveler, H. H. and Monroe, C. J.
(1928) J. Am. Chem. Soc., 50, 2421-6.
- Kazantzev, A. A.
(1923) Trans. Inst. Chem. Reagents, Moscow, No. 2, 10-27.
(1925) Chem. Abs., 19, 1218.
(1938) Zhur. Obs. Khimii, 8, 1230-1.
- Kazanzeff.
(1878) Ber. II, 1255.
- Keitel, H.
(1923) Kali, 7, 248, 261.
- Kellner, Geo.
(1917) Z. anorg. allgem. Chem., 99, 137-183.
- Kelly, W. J. and Ayers, K. B.
(1924) Ind. Eng. Chem., 16, 148-50.
- Kendall, J.
(1911) Proc. Roy. Soc. (Lond.), A, 85, 200-19.
(1912) Phil. Mag. [6], 23, 958.
- Kendall, J. and Davidson, J. G.
(1920) J. Am. Chem. Soc., 42, 1141-5.
- Kendall, J. and Davidson, A. W.
(1921) J. Am. Chem. Soc., 43, 979-90.
- Kendall, J. and Carpenter.
(1914) J. Am. Chem. Soc., 36, 2498.
- Kendall, J., Crittenden, E. D. and Miller, H. K.
(1923) J. Am. Chem. Soc., 45, 963-96.
- Kendall, J. and Landon, M. L.
(1920) J. Am. Chem. Soc., 42, 2131-42.
- Kendall, J. and Sloan, C. H.
(1925) J. Am. Chem. Soc., 47, 2306-17.
- Keppish.
(1888) Monatsh. Chem., 9, 589.
- Kernot, G., d'Agostino, E. and Pellegrino, M.
(1908) Gazz. chim. ital., 38, I, 532-54.
- Kernot, G. and Pomilio, M.
(1912) Rend. accad. sci. fis. nat. (Napoli), [3], 17, 353-8.
- Kern, E. and Jones, T.
(1930) Trans. Am. Electrochem. Soc., 57.
- Keschan, A.
(1925) Z. anal. Chem., 67, 81.
- Ketner.
(1901-02) Z. physik. Chem., 39, 645.
- Kettner, A.
(1919) Dissertation, Amsterdam.
- Keyes, D. B. and James, C.
(1914) J. Am. Chem. Soc., 36, 634.
- Kiang-su Chang and Yen-Ming Liu.
(1934) J. Chinese Chem. Soc., 2, 307-10.
- Kiehl, S. J. and Manfredo, E. J.
(1937) J. Am. Chem. Soc., 56, 2118-26.
- Kielland, J.
(1936) J. Am. Chem. Soc., 58, 426.
- Kilde, G.
(1934) Z. anorg. Chem., 218, 113-23.
(1936) Z. anorg. Chem., 229, 321-9.
- King, Harold and Pyman, F. L.
(1914) J. Chem. Soc. (Lond.), 105, 1238-59.
- King, F. E. and Partington, J. R.
(1926) J. Chem. Soc., 129, 20-22.
(1927) Trans. Faraday Soc., 23, 522-31.
- King, G. B.
(1937) J. Phys. Chem., 41, 797-801.

AUTHOR INDEX

- King, G. B. and Walton, J. H.
(1931) J. Phys. Chem., **35**, 1745-55.
- Kirejew, S. A. and Romantchok, M. A.
(1936) Zhur. Obs. Khimii, **6**, 78-84.
- Kirejew, S. A. and Wagranskaja, L. I.
(1935) Zhur. Obs. Khimii, **5**, 963-6.
- Kirn, E. R. and Dunlop, H. L.
(1931) J. Am. Chem. Soc., **53**, 391-4.
- Kirschfeld, L. and Sieverts, A.
(1929) Z. physik. Chem. (A), **145**, 229.
(1930) Z. Elektrochem., **31**, 123.
- Kirschner, A.
(1912) Z. physik. Chem., **79**, 247.
- v. Kiss, A., Lajtai, I. and Thury, G.
(1937) Z. anorg. Chem., **233**, 346-52.
- v. Kiss, A. and Urmanczy, A.
(1931) Z. anorg. Chem., **202**, 172-90.
- Kitaigorodski, Popowa and Botwinkin.
(1933) Iswestija, Instituta fizike
chimitsch analisi, **6**, 135.
- Klapproth, W.
(1922) Z. anal. Chem., **61**, 1-19.
- Klarmann, M. E.
(1924) Z. anorg. Chem., **132**, 290.
(1930) Z. physik. Chem., **65**, 358.
- Klaus.
(1905) Phys. Ztschr., **6**, 820.
- Klatchko-Gourvitch, L. L. and
Gandganov, N. O.
(1935) Zhur. Obs. Khimii, **5**, 1781-5.
- Klein, O.
(1912) Z. anorg. Chem., **74**, 158.
- Klein, O. and Svanberg, O.
(1920) Medd. Vetenskapsakad. Nobel
Inst., **4**, No. 1.
(1921) Chem. Abs., **15**, 1439.
- Klemenc, A. and Bankowski, O.
(1932) Z. anorg. Chem., **209**, 225-35.
- Klemenc, A. and Spitzer-Neumann, E.
(1929) Monatshefte. Chem., **53**, 413-9.
- Klemm, W. and Redeker, M.
(1931) Z. anorg. Chem., **200**, 345.
- Kleven.
(1872) Chem. Centralbl., **434**.
- Kline, W. D.
(1929) J. Am. Chem. Soc., **51**, 2093-7.
- Klinkenberg, A.
(1929) These, Delft.
- van Klooster, H. S.
(1910-11) Z. anorg. Chem., **69**, 122,
135-57.
(1912-13) Z. anorg. Chem., **79**, 223-9.
(1917) J. Phys. Chem., **21**, 513-18.
- van Klooster, H. S. and Balon, P. A.
(1934) J. Am. Chem. Soc., **56**, 591-2.
- van Klooster, H. S. and Stearns, E. I.
(1933) J. Am. Chem. Soc., **55**, 4121-3.
- Klose, G.
(1907) Archiv. Internat. Pharmacody-
namie et Therapie, **17**, 459-63.
- Klosky, S. and Woo, L.
(1926) J. Phys. Chem., **30**, 1179-80.
- Knietsch, R.
(1901) Ber., **34**, 4099.
- Knight, R. W. and Hinshelwood, C. N.
(1927) J. Chem. Soc. (Lond.), 466-72.
- Knopp.
(1904) Z. physik. Chem., **48**, 97-108.
- Knott, E.
(1932) Pharm. Jour. (Lond.), **128**, 84.
- Knox, Joseph.
(1909) J. Chem. Soc. (Lond.), **95**, 1760.
- Knox, J. and Will.
(1919) J. Chem. Soc., **115**, 853.
- Kobayashi, M.
(1911-12) Mem. Coll. Sci. Eng. (Kyoto),
3, 218.
- Koch, F. K.
(1930) J. Chem. Soc. (Lond.), 1551-8.
(1930a) J. Chem. Soc. (Lond.), 2385-6.
- Koenig, P. M.
(1922) Chimie et Industrie, **7**, 49.
- Koerker, F. W. and Calderwood, H. N.
(1938) J. Phys. Chem., **42**, 1151-5.
- Kofler, M.
(1913) Monatsh. Chem., **34**, 389.
(1913) Sitzber. k. Akad. Wiss. (Wien)
Abt., **11a**, **122**, 1473-80.
- Köhler.
(1879) Z. anal. Chem., **18**, 242.
- Köhler.
(1897) Z. Ver. Zuckerind., **47**, 447.

AUTHOR INDEX

Kohlrausch, Fr.

- (1879) Wied. Ann., 1,
- (1891) Ber., 24, 3561.
- (1891) Wied. Ann., 44, 577.
- (1897) Sitzber. k. Akad. Wiss. (Berlin), 90.
- (1903) Z. physik. Chem., 44, 197.
- (1904-05) Z. physik. Chem., 50, 355-6.
- (1908) Z. physik. Chem., 64, 121-69.

Kohlrausch, F. and Rose, F.

- (1893) Z. physik. Chem., 12, 129, 135, 241.

Kohn, H.

- (1909) Z. anorg. Chem., 63, 337-9.

Kohn, M. and O'Brien.

- (1898) J. Soc. Chem. Ind., 17, 100.

Kohn, M. and Klein, A.

- (1912) Z. anorg. Chem., 77, 254.

Kohnstamm and Cohn.

- (1898) Wied. Ann., 65, 344.

Kolb.

- (1872) Bull. soc. ind. Mulhouse, 222.

de Kolossovsky, N.

- (1911) Bull. soc. chim. (Paris), [4], 9, 623-7.
- (1911) Bull. soc. chim. (Belg.), 25, 183, 235.
- (1919) Bull. soc. chim. (Belg.), 28, 257-64.

de Kolossovsky, N. and Kulikow, F. S.

- (1934) Z. physik. Chem. (A), 169, 459.

Kolthoff, I. M.

- (1917) Chem. Weekblad., 14, 1081.
- (1921) Z. anorg. Chem., 119, 202-12.
- (1922) Rec. trav. chim., 41, 139.
- (1922) Chem. Weekblad., 19, 449.
- (1931) J. Phys. Chem., 35, 2711-21.

Kolthoff, I. M. and Bosch, W.

- (1932) J. Phys. Chem., 36, 1702-11.

Kolthoff, I. M. and Elmquist, R.

- (1931) J. Am. Chem. Soc., 53, 1217-24.

Kolthoff, I. M. and Rosenblum, C.

- (1933) J. Am. Chem. Soc., 55, 2656-64.

Kolthoff, I. M. and Stenger, V. A.

- (1934) J. Phys. Chem., 38, 639-43.

Kolthoff, I. M. and Vogelenzang, E. H.

- (1919) Z. anal. Chem., 58, 20, 51.

Konarzewski.

- (1931) Roczniki Chemji, 11, 516.

Konig.

- (1894) Monatsh. Chem., 15, 23.

de Koninck, L. L.

- (1907) Bull. soc. chim. (Belg.), 21, 141.

Konno, K.

- (1919) Mem. Coll. Sci., Kyoto, Imp. Univ., 4, 51-4.

Konowalow, D.

- (1898) Jour. Russ. Phys. Chem. Soc., [4], 30, 367.
- (1898) Chem. Zentralbl., II, 659.
- (1899a) Jour. Russ. Phys. Chem. Soc., 31, 910.
- (1899b) Jour. Russ. Phys. Chem. Soc., 31, 985.

Koppel, J.

- (1901-02) Z. physik. Chem., 42, 8.
- (1904) Z. anorg. Chem., 41, 377.
- (1905) Z. physik. Chem., 52, 405.
- (1906) Ber., 39, 3738.

Koppel, J. and Blumenthal, R.

- (1907) Z. anorg. Chem., 53, 228-67.

Koppel, J. and Cahn, M.

- (1908) Z. anorg. Chem., 60, 53-112.

Koppel-Gumpert.

- (1905) Z. physik. Chem., 52, 413.

Koppel, J. and Holtkamp, H.

- (1910) Z. anorg. Chem., 67, 274.

Koppel-Wetzel.

- (1905) Z. physik. Chem., 52, 395.

Korring, E.

- (1914) Neues Jahrb. Min. Geol. (Beil. Bd.), 37, 51-124.
- (1915) Z. anorg. Chem., 91, 194.

Körösy, F.

- (1937) Trans. Faraday Soc., 33, 416-25.

Korveze, A. E.

- (1934) Rec. trav. chim., 53, 464-70.

Kosakewitsch, P. P.

- (1929) Z. physik. Chem. (A), 143, 216-24.

Kournakov, N. S. and Zemcznyj, S. F.

- (1919) J. Russ. Phys. Chem. Soc., 51, 1-59.
- (1924) Z. anorg. allgem. Chem., 140, 149-82.

Kracek, F. C.

- (1931) J. Phys. Chem., 35, 417-22, 947-9.
- (1931) J. Am. Chem. Soc., 53, 2609-24.
- (1936) J. Wash. Acad. Sci., 26, 307-13.

AUTHOR INDEX

- Kragen, S.**
(1916) Monatshefte. Chem., **37**, 391.
- Krasnicki.**
(1887) Monatsh. Chem., **8**, 597.
- Kraus, C. A. and Burgess, W. M.**
(1927) J. Am. Chem. Soc., **49**, 1226-35.
- Kraus, C. A. and Glass, S. W.**
(1929) J. Phys. Chem., **33**, 995-9.
- Kraus, C. A. and Seward, R. P.**
(1927) Trans. Faraday Soc., **23**, 488-91.
(1928) J. Phys. Chem., **32**, 1294-1307.
- Kraus, C. A. and Lucasse, W. W.**
(1922) J. Am. Chem. Soc., **44**, 1949.
- Kraus, C. H. and Cuy, E. J.**
(1923) J. Am. Chem. Soc., **45**, 712.
- Krause, Erich.**
(1918) Ber., **51**, 1447-56.
- Krause, E. and Pohland, E.**
(1922) Ber., **55B**, 1282-1289.
- Krause, E. and Reiszsa, G. G.**
(1921) Ber., **54B**, 2062.
- Kremann, R., Daimer and Beunesch.**
(1911) Monatsh. Chem., **32**, 620.
- Kremann, R. and Hofmeier, F.**
(1908) Monatsh. Chem., **29**, 1111.
(1910) Monatshefte. Chem., **31**, 201.
- Kremann, R. and Hüttinger, K.**
(1908) Jahrb. k. Geol. Reichsanstalt (Wien), **58**, 637.
- Kremann, R. and Kerschbaum, F.**
(1907) Z. anorg. Chem., **56**, 218-22.
- Kremann, R. and Kropsch, R.**
(1914) Monatsh. Chem., **35**, 561, 823, 841.
- Kremann, R. and Noss, F.**
(1912) Monatsh. Chem., **33**, 1205.
- Kremann, R. and Pogantsch, K.**
(1923) Monatsh., **44**, 163-173.
- Kremann, R. and Rodemund, H.**
(1914) Monatsh. Chem., **35**, 1065-86.
(1914) Z. anorg. Chem., **86**, 373.
- Kremann, R. and Schinderschitsch, N.**
(1916) Monatsh., **37**, 649-79.
- Kremann, R. and Schoultz, R.**
(1912) Monatsh. Chem., **33**, 1063, 1081.
- Kremann, R. and Zawodsky, O.**
(1921) Monatsh., **41**, 543-53.
- Kremann, R. and Zitek, A.**
(1909) Monatsh. Chem., **30**, 311-40.
- Kremers.**
(1852) Pogg. Ann., **85**, 248.
(1854) Pogg. Ann., **92**, 497.
(1855) Pogg. Ann., **94**, 271; **95**, 468.
(1856) Pogg. Ann., **99**, 47.
(1856a) Pogg. Ann., **97**, 5.
(1858) Pogg. Ann., **103**, 57, 133, 165.
(1858) Pogg. Ann., **104**, 133.
(1860) Pogg. Ann., **111**, 60.
- Krepelka, J. H., and Rejha, B.**
(1933) Coll. Czechoslovak. Chem. Com., **5**, 67-75.
- Krepelka, J. H. and Toul, F.,**
(1929) Coll. Czechoslovak. Chem. Com., **1**, 155-64.
- Kritschewsky, I. and Goldmann, E.**
(1933) Z. anorg. Chem., **214**, 307-8.
(1934) Z. anorg. Chem., **218**, 253-4.
- Kritschewski, I. and Izkowitzsch, R. K.**
(1933) Z. anorg. Chem., **215**, 103-4.
- Kritchewsky, I. R. and Kasarnovsky, J. S.**
(1935) J. Am. Chem. Soc., **57**, 2168.
(1936) Z. physik. Chem., **176**, 48.
- Kritschewsky, I. R., Shawaronkoff, N. M. and Aepelbaum, V. A.**
(1935) Z. physik. Chem., (A), **175**, 232-8.
- Krug, W. H. and McElroy, K. P.**
(1892) J. Anal. Ch., **6**, 184.
- Krusemann, H. D.**
(1876) Ber., **9**, 1467.
- Krüss, G. and Nilson, L. F.**
(1887) Ber., **20**, 1696.
- Kruyt, H. R.**
(1908) Z. physik. Chem., **64**, 513.
(1908-09) Z. physik. Chem., **65**, 497.
(1912) Z. physik. Chem., **79**, 667.
- Kruyt, H. R. and Heldermann, W. D.**
(1916) Proc. Acad. Sci. Amsterdam, **19**, 439-47.
(1918) Z. physik. Chem., **93**, 89-107.

AUTHOR INDEX

- Krym, V.**
(1909) J. Russ. Phys. Chem. Soc., 41, 382-5; Chem. Zentr., II, 681.
- Kubie, L. S.**
(1927) J. Biol. Chem., 72, 545-8.
- Kugelmass, I. N. and Shohl, A. T.**
(1924) J. Biol. Chem., 58, 649-66.
- Kulisch.**
(1893) Monatsh. Chem., 14, 567.
- Kultascheff.**
(1903) Z. anorg. Chem., 35, 187.
- Kumpf.**
(1882) Wied. Ann. Beibl., 6, 276.
- Kunérth, W.**
(1922) Phys. Rev., [27], 19, 512-24.
- Kunhelm and Zimmerman.**
(1884) Dingler. polyt. J., 252, 478.
- Kunschert, F.**
(1904) Z. anorg. Chem., 41, 338.
- Küpper, A.**
(1927) Caliche, 8, 467.
- Kuriloff, B.**
(1897) Z. physik. Chem., 24, 441-67.
(1897a) Z. physik. Chem., 23, 93, 547.
673.
(1898) Z. physik. Chem., 25, 107, 419-40.
- Kurnakov, N. S.**
(1892) J. Russ. Phys. Chem. Soc., 24, 629.
(1893) J. Chem. Soc. (Lond.), 64, ii, 509.
(1916) J. Russ. Phys. Chem. Soc., 48, 1672.
- Kurnakov, N. S. and Kanov, F. P.**
(1924) Z. anorg. Chem., 135, 102.
- Kurnakov, J., Krotkov, D. and Oksman, M.**
(1915) Jour. Russ. Phys. Chem. Soc., 47, 558-88.
- Kurnakov, N. S. and Nikolajew, W. M.**
(1926) J. Russ. Phys. Chem. Soc., 58, 548.
(1927) Z. physik. Chem., 130, 193.
- Kurnakov, N. S. and Perelmutter, G.**
(1924) Z. anorg. Chem., 135, 114.
- Kurnakov, N. S., Perelmutter, G. and Kanov, F. P.**
(1915) Ann. Polytechn. Petrograd, 24, 399.
- Kurnakov, N. S. and Rawitsch, M. I.**
(1933) Ann. Inst. Phys. Chem. Anal. (Russ), 6, 169.
- Kurnakov, N. S. and Wrzesnewsky, J. B.**
(1912) Z. anorg. Chem., 74, 89.
- Kurtenacker, A., Finger, W. and Hey, F.**
(1933) Z. anorg. Chem., 211, 83-97, 281-95.
- Kurtenacker, A. and Fluss, W.**
(1933) Z. anorg. Chem., 210, 125-34.
- Kurtenacker, A. and Laszlo, G.**
(1938) Z. anorg. Chem., 237, 359-68.
- Küster, F. W. and Heberlein, E.**
(1905) Z. anorg. Chem., 43, 56.
- Küster, F. W. and Kremann, R.**
(1904) Z. anorg. Chem., 41, 19.
- Küster and Thiel.**
(1899) Z. anorg. Chem., 21, 116.
(1903) Z. anorg. Chem., 33, 139.
- Lachartre, M.**
(1924) Bull. soc. chim., [4], 35, 321-32.
- Lachaud, M. and Lepierre, C.**
(1891) Bull. soc. chim., [3], 6, 230-5.
- Ladenburg, A.**
(1902) Ber., 35, 1256.
- Lafontaine, G. H.**
(1925) Compt. rend., 180, 2045.
- Laird, J. S.**
(1920) J. Phys. Chem., 24, 736.
- Lal De, R.**
(1917) J. Chem. Soc. (Lond.), 111, 55.
- Lamb, A. B. and Phillips, A. W.**
(1923) J. Am. Chem. Soc., 45, 108-12.
- Lamb, A. B. and Simmons, J. P.**
(1921) J. Am. Chem. Soc., 43, 2196.
- Lambert, R. H.**
(1926) J. Phys. Chem., 30, 973-9.
- LaMer, V. K. and Cook, R. G.**
(1929) J. Am. Chem. Soc., 51, 2622.
- LaMer, V. K. and Goldman, F. H.**
(1929) J. Am. Chem. Soc., 51, 2632-45.
(1930) J. Am. Chem. Soc., 52, 2791-3.
(1931) J. Am. Chem. Soc., 53, 473-6.
- LaMer, V. K., King, C. V. and Mason, C. F.**
(1927) J. Am. Chem. Soc., 49, 363.
- LaMer, V. K. and Lewinsohn, M. H.**
(1934) J. Phys. Chem., 38, 171-95.
- LaMer, V. K. and Mason, C. F.**
(1927) J. Am. Chem. Soc., 49, 410.
- Lami, Pio.**
(1908) Chem. Zentr., II, 755.

AUTHOR INDEX

- ourous, F.
(1899) Compt. rend., 128, 998.
- y.
(1863) Ann. chim. phys., [3], 67, 408.
(1878) Ann. chim. phys., [5], 14, 145.
- du, M.
(1893) Monatsh. Chem., 14, 712.
(1910) Z. physik. Chem., 73, 200-11.
- ganer, D.
(1933) Z. anorg. Chem., 213, 180.
- gdon, G. M.
(1923-4) Trans. Faraday Soc., 19, 285.
- ge, W.
(1927) Ber., 60, 962.
(1929) Ber., 62, 793.
- gheld, K. and Oppmann, F.
(1912) Ber., 45, 3753.
- gley, W. D., Rosenbaum, M. G. and
osenbaum, M. M.
(1932) J. Biol. Chem., 99, 271-8.
- nung, Axel.
(1930) J. Am. Chem. Soc., 52, 68-80.
(1932) Z. physik. Chem. (A), 161, 255-78.
(1934) Z. physik. Chem. (A), 170, 144.
- za, J.
(1931) Anales, soc. Esp. fis. quim., 29,
221-34.
- zing, Miss J. C.
(1928) Ric. trav. chim., 47, 901-3.
- ocque, G. L. and Maass, O.
(1935) Canadian, J. Res., 13, 276-9.
- erson, A. T. and Black, C. A.
(1925) Ind. Eng. Chem., 17, 715.
(1925) J. Am. Chem. Soc., 47, 1015-20.
- erson, E.
() Svensk Kemisk Tidschrift, 39, 122.
- erson, E. and Adell, B.
(1931) Z. anorg. Chem., 196, 354-63.
- erson, R. G. and Hunt, H.
(1939) J. Phys. Chem., 43, 417-23.
- ssaigne.
(1876) J. chim. med., 12, 177.
- h Lasczynski, St.
(1894) Ber., 27, 2285.
- ctey, R.
(1923) Dissertation, Braunschweig.
- Laue, Erich.
(1927) Z. anorg. Chem., 165, 325-63.
- Lauffenburger, R. and Brodsky, M.
(1938) Compt. rend., 206, 1383-5.
- Laurie, A. P.
(1912) Proc. Roy. Soc. (Edin.), 31, 388.
- Lautsberry, F. C. A. H. and Page, R. A.
(1920) J. Soc. Chem. Ind., 39, 37.
- Lawrence, R. W. and King, G. B.
(1938) J. Am. Chem. Soc., 60, 1987-8.
- Laybourn, K. and Madgin, W. M.
(1932) J. Chem. Soc. (Lond.), 2582-9.
(1933) J. Chem. Soc. (Lond.), 236-40.
- Laybourn, K., Madgin, W. M. and Freeman, D.
(1934) J. Chem. Soc. (Lond.), 139-46.
- Lea, Chas. and Wood, J. K.
(1924) J. Chem. Soc., 125, 137-48.
- Leaming, Thos. H.
(1925?) Renesselaer, Polytech. Inst.
(Troy, N. Y.) Eng. Sci.
Series. No. 7.
- Leather, J. W. and Mukerji, J. M.
(1913) Mem. Dept. Agr. (India), Chem.
Ser., 3, 177-204.
- Leather, J. W. and Sen, J. N.
(1909) Mem. Dept. Agr. (India), Chem.
Ser., 1, 117-31.
(1914) Mem. Dept. Agr. (India), Chem.
Ser., 3, 205-34.
- Lebeau, P.
(1906) Ann. chim. phys., [8], 9, 482-4.
(1911) Compt. rend., 152, 440.
- Lebedew, P.
(1911) Z. anorg. Chem., 70, 302, 316.
- LeBlanc, M. and Harnapp, O.
(1932) Z. physik. Chem., 166, 333.
- LeBlanc, M. and Novotny, K.
(1906) Z. anorg. Chem., 51, 181-201.
- LeBlanc, M. and Noyes, A. A.
(1890) Z. physik. Chem., 6, 386.
- LeBlanc, M. and Schmandt, W.
(1911) Z. physik. Chem., 77, 621-30.
- Le Boucher, L.
(1926) Anales. Soc. Espan. fis. quim.
24, 95, 277.

AUTHOR INDEX

- LeChatelier.
(1894) *Compt.rend.*, 118, 350, 709, 800.
(1897) *Compt.rend.*, 124, 1094.
- Ledrut, J. and Hauss, L.
(1932) *Bull.soc.chim.(Belg.)*, 41, 104-7.
(1937) *Bull.soc.chim.(France)* [5], 4, 1136-41.
- Lee, F. H. and Lee, K. H.
(1936) *J.Chinese Chem.Soc.*, 4, 126-30.
- Lee, W. B. and Egerton, A. C.
(1923) *J.Chem.Soc.*, 123, 706-16.
- van Leeuwen, J. Docters.
(1897) *Z.physik.Chem.*, 23, 44.
- LeFevre, R. J. W.
(1932) *J.Chem.Soc.(Lond.)*, 2503-4.
- Lefort.
(1878) *Ann.chim.phys.*, [5], 15, 326.
- Legerlotz, H.
(1918) *Arch.Pharm.*, 256, 162-3.
- Lehrman, A., Adler, E. Jacob, F. and Niemand, M.
(1937) *J.Am.Chem.Soc.*, 59, 179-81.
- Lehrman, A. and Breslow, D.
(1938) *J.Am.Chem.Soc.*, 60, 873-6.
- Lehrman, A. and Leifer.
(1938) *J.Am.Chem.Soc.*, 60, 142-4.
- Lehrman, A., Selditch, H. and Skell, P.
(1936) *J.Am.Chem.Soc.*, 58, 1612-5.
- Leick, J.
(1932) *Z.anal.Chem.*, 87, 415-22.
(1933) *Z.anorg.Chem.*, 210, 203-9.
- Leidie.
(1882) *Compt.rend.*, 95, 87.
(1890) *Compt.rend.*, 111, 107.
- Leikina, B. N. and Nowosselowa, A. W.
(1937) *Zhur.Obs.Khimii*, 7, 241-8.
- Leinbach, G. and Pfeiffenberger, A.
(1929) *Caliche*, 11, 61.
(1930) *Caliche*, 12, 340.
- Le marchands, M.
(1928) *Compt.rend.*, 187, 601.
- Lenher, V. and Kao, C. H.
(1926) *J.Am.Chem.Soc.*, 48, 1550-6.
- Lenher, V. and Merrill, H. B.
(1917) *J.Am.Chem.Soc.*, 39, 2630.
- Leo, Rudolf.
(1923) *Monatsh.*, 43, 567-88.
- Lepierre, C. and Lachaud, M.
(1891) *Compt.rend.*, 113, 196.
- Lespiau.
(1894) *Bull.soc.chim.*, [3], 11, 72.
- Levi, G. R.
(1923) *Atti accad.Lincei* [5], 32, I, 623-6.
- Levi, G. R. and Aguzzi, A.
(1938) *Gazz.chim.ital.*, 68, 179-84.
- Levi, M. G.
(1901) *Gazz.chim.ital.*, 31, 11, 523.
(1902) *Z.physik.Chem.*, 41, 110.
- Levi-Malvano, M.
(1906) *Z.anorg.Chem.*, 48, 446.
(1905) *Atti accad.Lincei*, [5], 14, II, 502-10.
- Levi, Miriam and Gilbert, F.
(1927) *J.Chem.Soc.(Lond.)*, 130, 2117-24.
- Levi, S. M.
(1923) *Z.physik.Chem.*, 106, 93-104.
(1924) *Z.physik.Chem.*, 108, 411-30.
- Lewis, G. N. and Storch, H.
(1917) *J.Am.Chem.Soc.*, 39, 2551.
- Lewis, N. B. and Rivett, A. C. D.
(1924) *J.Chem.Soc.*, 125, 1156-67.
- Ley, H. and Heimbuchen.
(1904) *Z.Elektrochem.*, 10, 303.
- Ley, H. and Schaefer, K.
(1906) *Ber.*, 39, 1263.
- Lichacjova, A. I. and Lucinsky, G. P.
(1938) *Zhur.Obs.Khimii*, 8, 916-23.
- Lichty, D. M.
(1903) *J.Am.Chem.Soc.*, 25, 474.
- Lidoff.
(1893) *Bull.soc.chim.*, [3], 10, 356.
- Liebermann, C.
(1902) *Ber.*, 35, 1094.
(1903) *Ber.*, 36, 180.
- van Liempt, J. A. M. and Van Wijk, W.
(1937) *Rec.trav,chim.*, 56, 632-4.
- Limbosch, H.
(1909) *Bull.soc.chim.Belg.*, 23, 179-200.

AUTHOR INDEX

- Lind, S. C., Underwood, J. E. and Whittemore, C. F.
(1918) J. Am. Chem. Soc., 40, 465-72.
- van der Linden, T.
(1916) Arch. Suikerind., 24, 1113-28.
(1917) Chem. Abs., 11, 3122.
- Lindner, J.
(1912) Monatsh. Chem., 33, 645.
- Lindstrand, F.
(1936) Z. anorg. Chem., 230, 187-208.
- Linebarger, C. E.
(1892) Am. Chem. Jour., 14, 380.
(1894) Am. Chem. Jour., 16, 214.
(1895) Am. Jour. Sci., 49, 48-53.
- Lineweaver, H.
(1938) J. Biol. Chem., 122, 548-67.
- Linhard, M.
(1938) Z. anorg. Chem., 239, 155-60.
- Linhard, M. and Stephan, M.
(1933) Z. physik. Chem., 163, 185-95.
(1934) Z. physik. Chem., 167, 87-102.
- Linhart, G. A.
(1915) J. Am. Chem. Soc., 37, 258-74.
(1918) J. Am. Chem. Soc., 40, 158-63.
- Linz, A.
(1939) Ind. Eng. Chem., 31, 302.
- Liou Qui Tao and Wang Shim Mo.
(1936) Compt. rend., 202, 846.
- Lloyd, E., Brown, C. B., Glynwyn, D., Bonnel, R. and Jones, W. J.
(1928) J. Chem. Soc. (Lond.), 658-66.
- Lloyd, S. J.
(1918) J. Phys. Chem., 22, 300-3.
- Locke.
(1901) Am. Chem. J., 26, 174.
(1902) Am. Chem. J., 27, 459.
- Locuty, P. and Laffitte, P.
(1933) Compt. rend., 196, 1311.
(1934) Compt. rend., 199, 950.
- Loewel.
(1851) Ann. chim. phys., [3], 33, 382.
(1855) Ann. chim. phys., [3], 43, 413.
- Logan, M. A. and Taylor, H. L.
(1937) J. Biol. Chem., 119, 293-306.
- Long.
(1888) J. Anal. Chem., 2, 243.
- Longi.
(1883) Gazz. chim. ital., 13, 87.
- Longuimine.
(1862) Liebig's Ann., 121, 123.
- Lorah, J. R., Tartar, H. V. and Wood, L.
(1929) J. Am. Chem. Soc., 51, 1097-1106.
- Loomis, A. G.
(1922) J. Am. Chem. Soc., 44, 8-19.
- Lord, R. C.
(1907) J. Phys. Chem., 11, 182.
- Lorenz, R. and Bergheimer, E.
(1924) Z. anorg. allgem. Chem., 137, 141-54.
- Lorenz, R. and Winger, R.
(1929) Z. anorg. Chem., 183, 121-6.
- Lorenz, R., Jabs, A. and Eitel, S.
(1913) Z. anorg. Chem., 83, 39.
- Lorenz and Ruckstuhl.
(1906) Z. anorg. Chem., 51, 70.
- Losana, L.
(1923) Gazz. chim. ital., 53, 396-410.
(1926) Gazz. chim. ital., 56, 301-31.
- Lothian, J.
(1909) Pharm. Jour. (Lond.), 82, 292.
- Löwel.
(1851) Ann. chim. phys., [3], 33, 382.
- Löwenherz, R.
(1894) Z. physik. Chem., 13, 479.
(1895) Z. physik. Chem., 18, 82.
(1898) Z. physik. Chem., 25, 395-410.
- Lowery, H. H. and Erickson, W. R.
(1927) J. Am. Chem. Soc., 49, 2729-34.
- Lowry, T. M. and Gilbert, F. L.
(1929) J. Chem. Soc. (Lond.), 2076-87.
- Lowry, T. M., McHatton, L. P. and Jones, G. G.
(1927) J. Chem. Soc. (Lond.), 130, 746-56.
- Lowry, T. M. and Lemon, J. T.
(1935) J. Chem. Soc. (Lond.), 692-6.
(1936) J. Chem. Soc. (Lond.), 1-11.
- Lowry, T. M., Lloyd, E. and Lloyd, W. V.
(1936) J. Chem. Soc. (Lond.), 11-17.
- Lubarsch.
(1889) Wied. Ann. Physik., [2], 37, 525.
- Lubavin.
(1892) J. Russ. Ph. Chem. Soc., 24, 389.

AUTHOR INDEX

- de Lucchi, G.
 (1910) Russ. min., 32, 21.
 (1910) "Tables annuelles," I, 381, 403.
- Luckenmeyer-Hasse and Shenk.
 (1932) Arch. Eisenhüttenw., 6, 210.
- Lugg, J. W. H.
 (1931) Trans. Faraday Soc., 27, 297-309.
- Lukens, H. S.
 (1932) J. Am. Chem. Soc., 54, 2372-80.
- Lumsden, J. S.
 (1902) J. Chem. Soc. (Lond.), 81, 355.
 (1905) J. Chem. Soc. (Lond.), 89, 90.
- Lunge,
 (1885) J. Soc. Chem. Ind., 4, 32.
 (1892) J. Soc. Chem., Ind., 11, 882.
- Luther, R. and Leubner, A.
 (1912) J. prakt. Chem., [2], 85, 314.
 (1912a) Z. anorg. Chem., 74, 389.
- Lutschinsky, G. P.
 (1935) Z. anorg. Chem., 224, 420-6.
- Lutschinsky, G. P. and Lichatschewa, A. I.
 (1935) Z. anorg. Chem., 225, 175-6.
- Maass, O. and Hatcher, W. A.
 (1922) J. Am. Chem. Soc., 44, 2473.
- Maass, O. and Herzberg, O. W.
 (1920) J. Am. Chem. Soc., 42, 2569-70.
- Maass, O. and McIntosh, D.
 (1912) J. Am. Chem. Soc., 34, 1279.
 (1913) J. Am. Chem. Soc., 35, 538.
- Maass, O. and Russell, J.
 (1921) J. Am. Chem. Soc., 43, 1227.
- Maben.
 (1883-84) Pharm. Jour. (Lond.), [3],
 14, 505.
- MacAdam, D. J., Jr. and Pierle, C. A.
 (1912) J. Am. Chem. Soc., 34, 604.
- Macalpine, G. B. and Sayce, L. A.
 (1932) J. Chem. Soc. (Lond.), 1560-5.
- McAmis, A. J. and Felsing, W. A.
 (1925) J. Am. Chem. Soc., 47, 2633.
- MacArthur, C. G.
 (1916) J. Phys. Chem., 20, 495.
- McBain, J. W., Brock, G. C., Vold, R. D. and
 Vold, M. J.
 (1938) J. Am. Chem. Soc., 60, 1870-6.
- McBain, J. W. and Eaton, M.
 (1928) J. Am. Chem. Soc., 131, 2166-79.
- McBain, J. W. and Field, M. C.
 (1933) J. Chem. Soc. (Lond.), 920-32.
 (1933) J. Am. Chem. Soc., 55, 4776-93.
- McBain, J. W., Lozarus, L. H. and Pitten, A. V.
 (1930) Z. physik. Chem. (A), 147, 87-117.
- McBain, J. W. and Stewart, A.
 (1933) J. Chem. Soc. (Lond.), 924-32.
- McBain, J. W., Vold, R. D. and Jameson, W. T.
 (1939) J. Am. Chem. Soc., 61, 30-7.
- McBride, R. S.
 (1910) J. Phys. Chem., 14, 189-200.
- McCaughy, W. J.
 (1909) J. Am. Chem. Soc., 31, 1261.
- McCombie, H. and Reade, T. H.
 (1923) J. Chem. Soc., 123, 151.
- McCoy, H. N. and Smith, H. J.
 (1911) J. Am. Chem. Soc., 33, 468-73.
- McCoy, H. N. and Test, Chas. D.
 (1911) J. Am. Chem. Soc., 33, 473-6.
- McCrae, J. and Wilson, W. E.
 (1903) Z. anorg. Chem., 35, 11.
- McCrosky, C. R. and Buell, H. D.
 (1920) J. Am. Chem. Soc., 42, 1788.
- McCulloch, L.
 (1937) J. Am. Chem. Soc., 59, 2650-2.
- M' David, J. W.
 (1909-10) Proc. Roy. Soc. (Edinburgh),
 30, 440-7.
- McDaniel, A. S.
 (1911) J. Phys. Chem., 15, 587-610.
- McDermott, F. Alex.
 (1911) J. Am. Chem. Soc., 33, 1963.
- McDonnell, C. C. and Smith, C. M.
 (1916) J. Am. Chem. Soc., 38, 2366.
- MacDougall, F. H.
 (1930) J. Am. Chem. Soc., 52, 1390-3.
- MacDougall, F. H. and Bartsch, C. E.
 (1936) J. Phys. Chem., 40, 649-59.
- MacDougall, F. H. and Hoffman, E. J.
 (1936) J. Phys. Chem., 40, 317-31.
- MacDougall, F. H. and Larson, W. D.
 (1937) J. Phys. Chem., 41, 417-29.

AUTHOR INDEX

- MacDougall, F. H. and Rehner, John, Jr.
(1934) J. Am. Chem. Soc., 56, 368-72.
- MacDougall, G. and Davies, C. W.
(1935) J. Chem. Soc. (Lond.), 1416-19.
- McDowell, L. A. and Johnston, H. L.
(1936) J. Am. Chem. Soc., 58, 2009-14.
- MacFarlane, W. and Wright, R.
(1934) J. Chem. Soc. (Lond.), 207-10.
- McIntosh, D.
(1903) J. Phys. Chem., 7, 350.
(1911) J. Am. Chem. Soc., 33, 71.
(1928) Bull. Chem. Soc. (Japan), 3, 82-6.
- McKelvy, E. C. and Simpson, D. H.
(1922) J. Am. Chem. Soc., 44, 105-15.
- Mackenzie.
(1877) Wied. Ann. Physik., [2], 1, 450.
- McKenzie.
(1899) J. Chem. Soc. (Lond.), 75, 969.
- McKie, P. V.
(1921) J. Chem. Soc., 119, 777-9.
- McLauchlan, W. H.
(1903) Z. physik. Chem., 44, 600-33.
- Maclaurin.
(1893) J. Chem. Soc. (Lond.), 63, 729.
- McMaster, LeRoy and Pratte, P. K.
(1923) J. Am. Chem. Soc., 45, 2999.
(1924) Chem. News, 129, 4-6.
- Macy, R.
(1925) J. Am. Chem. Soc., 47, 1031-6.
- Macy, R. and Thomas, E. W.
(1926) J. Am. Chem. Soc., 48, 1547-50.
- Madgin, W. M. and Briscoe, H. V. A.
(1923) J. Chem. Soc., 123, 2914-6.
- Madson, W. H. and Krauskopf, F. C.
(1931) Rec. trav. chim., 50, 1005-10.
- Maeda, T. and Yamane, S.
(1928) Bull. Inst. Phys. Chem. Res.
(Tokyo), 7, 340.
- Magnanini, G.
(1901) Gazz. chim. ital., 31, II, 542.
- Mahieu, J.
(1936) Bull. soc. chim. (Belg.), 45,
667-75.
- Mal, J.
(1928) Ber., 61, 1808.
- Malgret.
(1905) Bull. soc. chim. [3], 33, 631.
- von Mailfert.
(1894) Compt. rend., 119, 951.
- Mainzer, F. and Bruhu, M.
(1931) Biochem. Z., 230, 395-410.
- Majer, V.
(1928) Listy cukrovar, 47, 123-136.
- Makarow, S. Z.
(1932) Zhur. Obs. Khimii, 2, 234-48.
- Makarow, S. Z. and Jakimow, M. N.
(1933) Zhur. Obs. Khimii, 3, 990-7.
- Makarow, S. Z. and Wachsberg, N. M.
(1930) Zhur. Obs. Khimii, 62, 1863.
- Malhotra, K. L.
(1928) J. Indian Chem. Soc., 5, 545-7.
- Malhotra, K. L. and Suri, H. D.
(1930) J. Phys. Chem., 34, 2103-10.
- Maljaroff, K. L. and Gluschakoff, A. J.
(1933) Z. anal. Chem., 93, 265-8.
- Maljaroff, K. L. and Matskiewitsch, W. B.
(1934) Z. anal. Chem., 98, 31-3.
- Mallet.
(1897) Am. Chem. Jour., 19, 807.
- Malmy, M.
(1926) J. pharm. chim., [8], 4, 111-4.
- Malossi, L.
(1931) Atti accad. Lincei [6], 13, 775-9.
- Malquori, G.
(1925) Atti accad. Lincei., [6], 1, 392.
(1926) Gazz. chim. ital., 56, 37-41, 51-55.
(1926) Atti del II Congress di Chim.
Palermo, 1136
(1927) Atti accad. Lincei [6], 5, 510.
(1927a) Atti accad. Lincei [6], 5, 576-8.
(1927b) Gazz. chim. ital., 57, 661-6.
(1927c) Atti accad. Lincei, [6], 5, 892-6.
(1927d) Atti accad. Lincei [6], 5, 451-2.
(1927e) Atti accad Lincei [6], 5, 801-2.
(1927f) Atti accad Lincei [6], 5, 1000.
(1928) Gazz. chim. ital., 58, 209-16.
(1928) Atti accad. Lincei [6], 7, 740
(1928a) Gazz. chim. ital., 58, 891-8.
(1928b) Gazz. chim. ital., 58, 562-8.
(1928c) Gazz. Chim. ital., 58, 781-91.
(1928d) Gazz. chim. ital., 58, 203.
(1929) Gazz. chim. ital., 59, 556-63.
(1929a) Atti accad Lincei [6], 9, 569-72.
(1929b) Atti accad. Lincei [6], 9, 324, 414.
- Mameli, E.
(1922) Giorn. chim. ind. app., 4, 293-96.

AUTHOR INDEX

- Manchot, W. and Ortner, K.**
(1922) *Z. anorg. allgem. Chem.*, **120**, 300.
- Manchot, W. and Reinburger.**
(1926) *Ber.*, **59B**, 2672-81.
- Manchot and Zechentmayer.**
(1906) *Liebig's Ann.*, **350**, 368.
- Mandelbaum, R.**
(1909) *Z. anorg. Chem.*, **62**, 370-82.
- Mansuri, Q. A.**
(1927) *J. Chem. Soc. (Lond.)*, **130**, 2993-5.
(1928) *J. Chem. Soc. (Lond.)*, 2107-8.
- Manuelli, A.**
(1916) *Ann. chim. applicata*, **5**, 13-24.
- Mar.**
(1892) *Am. J. Sci.*, **[3]**, 43, 521.
- Marc, R.**
(1906) *Z. anorg. Chem.*, **48**, 425.
(1907) *Z. anorg. Chem.*, **53**, 301.
- Marckwald, W.**
(1902) *Ber.*, **35**, 1599.
(1904) *Ber.*, **37**, 1041.
- Marden, J. W.**
(1914) *J. Ind. Eng. Chem.*, **6**, 315-20.
(1916) *J. Am. Chem. Soc.*, **38**, 310.
- Marden, J. W. and Dover, Mary V.**
(1916) *J. Am. Chem. Soc.*, **38**, 1239.
(1917) *J. Am. Chem. Soc.*, **39**, 4.
- Margoscher, Hinner and Friedmann.**
(1924) *Z. anorg. Chem.*, **137**, 83.
- Marle, C. and Marquis, R.**
(1903) *Compt. rend.*, **136**, 684.
- Marignac.**
(1853) *Ann. chim. phys.*, **[37]**, 39, 184.
(1861) *J. prakt. Chem.*, **83**, 202.
(1866) *Ann. chim. phys.*, **[4]**, 8, 65.
- Marino.**
(1905) *Gazz. chim. ital.*, **35**, **II**, 351.
- Marsh, J. K.**
(1939) *J. Chem. Soc. (Lond.)*, 554-8.
- Marsh, J. E. and Struthers, R. de J. F.**
(1905) *J. Chem. Soc. (Lond.)*, **87**, 1879.
- Marshall, A.**
(1906) *J. Chem. Soc. (Lond.)*, **89**, 1381.
- Marshall.**
(1891) *J. Chem. Soc. (Lond.)*, **59**, 771.
- Marshall, H. and Bain, D.**
(1902) *J. Chem. Soc. (Lond.)*, **97**, 1074-85.
- Martin.**
() These, Bruxelles.
- Martin.**
(1929) *Arch. Eisenhütten w.*, **3**, 412.
- Marvel, C. S. and Glavis, F. J.**
(1936) *J. Am. Chem. Soc.*, **60**, 2622-26
- Masaki, Kosaku.**
(1930) *Bull. chem. soc. (Japan)*, **5**, 345.
(1931) *Bull. chem. soc. (Japan)*, **6**, 143, 163.
- Mascarelli, L.**
(1906) *Atti accad. Lincei*, **[51]**, **15**, **I**, 192; **II**, 459.
(1906a) *Atti accad. (Lincei)*, **[51]**, **15**, 192.
(1906a) *Gazz. chim. ital.*, **36**, **II**, 880-93.
(1908) *Atti accad. Lincei*, **[51]**, **17**, **I**, 29.
(1909) *Gazz. chim. ital.*, **39**, **I**, 251-84.
- Mascarelli, L. and Ascoli, U.**
(1907) *Gazz. chim. ital.*, **37**, **I**, 125.
- Mason, C. W. and Ashcraft, E. B.**
(1939) *Ind. Eng. Chem.*, **31**, 768-74.
- Mason, C. W. and Forgeng, W. D.**
(1931) *J. Phys. Chem.*, **35**, 1123-32.
- Mason, R. B. and Mathews, J. H.**
(1925) *J. Phys. Chem.*, **29**, 1179-83.
- Massink, A.**
(1917) *Chem. Weekblad.*, **14**, 756.
(1916-18) *Z. physik. Chem.*, **92**, 351-80.
- Massol and Maldes.**
(1901) *Compt. rend.*, **133**, 287.
- Masson, I.**
(1912-13) *Proc. Roy. Soc. (Edin.)*, **33**, 64-8.
(1931) *J. Chem. Soc. (Lond.)*, 3200.
- Masson, J. J. Orme.**
(1911) *J. Chem. Soc. (Lond.)*, 99, 1132.
(1912) *J. Chem. Soc. (Lond.)*, 101, 103.
- Matheson, G. L. and Maass, O.**
(1929) *J. Am. Chem. Soc.*, **51**, 674.
- Mathews, J. H. and Bengier, E. B.**
(1914) *J. Phys. Chem.*, **18**, 264.
- Mathews, J. H. and Ritter, P. A.**
(1917) *J. Phys. Chem.*, **21**, 269-74.
- Mathews, J. H. and Spero, S.**
(1917) *J. Phys. Chem.*, **21**, 402-6.
- Matthews, H. E. and Davies, C. W.**
(1933) *J. Chem. Soc. (Lond.)*, 1435.
- Mathur, R. P. P. and Dhar, N. F.**
(1931) *Z. anorg. Chem.*, **199**, 387-91.

AUTHOR INDEX

Matignon, C.

- (1906) Ann.chim.phys., [8], 8, 249, 388, 407.
- (1909) 7th Internat. Cong. Appl. Chem., 2, 53-57.
- (1909a) Compt.rend., 148, 550.

Matignon, C. and Meyer, F.

- (1917) Compt.rend., 165, 787-9.
- (1918) Compt.rend., 166, 115-8, 686-8.
- (1918) Ann.chim., [9], 251-292.

Matignon, C. and Valentin, J.

- (1923) Bull.soc.chim., [4], 33, 267-80.

Matsin, M., Oguri, S., Noda, H. and Kumagi, N.

- (1929) J.Soc.Chem.Ind. (Japan), 32, 229.

Matsumoto.

- (1916) J.Chem.Soc. (Japan), 37, 324.

Matsuura, S.

- (1927) Bull.Chem.Soc. (Japan), 2, 44-8.

Matthes, F.

- (1911) Neues Jahrb.Min.Geol. (Beil. Bd.), 31, 342-85.

Maumee.

- (1864) Compt.rend., 58, 81.

May, O. E., Welsberg, S. M. and Herrick, H. T.

- (1929) J.Wash.Acad.Sci., 19, 443.

Mayeda, T.

- (1920) J.Chem.Ind.Tokyo, 23, 573, 954, 1132.

Mayer.

- (1856) Liebig's Ann., 98, 193.

Mayer, O.

- (1903) Ber., 36, 1741.

Maxted, E. B. and Moon, C. H.

- (1936) Trans.Faraday Soc., 32, 769.

Mazatto.

- (1891) Nuovo.cimento, [3], 29, 21.

Mazzetti, C.

- (1926) Gazz.Chim.Ital., 56, 601.
- (1929) Am.chim.applicata, 19, 273-82.

Mazzucchelli, A. and Rosa, A.

- (1921) Atti accad.Lincei, [51], 30, 11, 270-2.

Mebane, W. M., Dobbin, J. T. and Cameron, F. K.

- (1929) J.Phys.Chem., 33, 961-9.

Meerburg, P. A.

- (1902) Z.physik.Chem., 40, 647.
- (1903) Z.anorg.Chem., 37, 203.
- (1904) Chem.Weekblad., 1, 474.
- (1905) Z.anorg.Chem., 45, 1, 324.
- (1908) Z.anorg.Chem., 59, 136-42.
- (1909) van Bemmen Festschrift, 356-60.
- (1911) Chem.Zentralbl., 1, 1036.

Meerum-Terwogt.

- (1905) Z.anorg.Chem., 47, 203.

Mees, C. E. K. and Piper, C. W.

- (1912) Photogr.Jour., 33, 227.
- Photogr.Jour., 36, 234.
- Photogr.Jour., 52, 221-37.

Mees, Graham.

- (1938) J.Am.Chem.Soc., 60, 870-1.

Meineke.

- (1891) Liebig's Ann., 261, 360.

Meissner, A.

- (1919) Zement., 8, 296, 308.

Melbye, G. S.

- (1922) Medd.Vetenskapsakad.Nobel Inst., 4, No. 8.

Melcher, A. C.

- (1910) J.Am.Chem.Soc., 32, 50-66.

Meneghini, D.

- (1912) Gazz.chim.ital., 42, 11, 474.

Menge, Otto.

- (1911) Z.anorg.Chem., 72, 169-218.

Menke, J. B.

- (1912) Z.anorg.Chem., 77, 283.

Menschutkin, B. N.

- (1905) Mem.St.Petersburg Polyt. Inst., 4, 75-101.
- (1906) Mem.St.Petersburg Polyt.Inst., 5, 355-88.
- (1907) Z.anorg.Chem., 52, 9, 155; 53, 26.
- (1907a) Z.anorg.Chem., 54, 89-96.
- (1908) Mem.St.Petersburg Polyt.Inst., 9, 200-22.
- (1909) Z.anorg.Chem., 61, 106, 113.
- (1909) Mem.St.Petersburg Polyt.Inst., 11, 261, 567; 12, 1.
- (1909a) J.Russ.Phys.Chem.Soc., 41, 1089.
- (1910) Mem.St.Petersburg Polyt.Inst., 13, 1, 263, 411, 565; 14, 251.
- (1911) Mem.St.Petersburg Polyt.Inst., 15, 65, 397, 613, 647, 757.
- (1912) Mem.St.Petersburg Polyt.Inst., 16, 33, 397.

AUTHOR INDEX

- Menzel, Heinrich.**
 (1923) Z. physik. Chem., 105, 425.
 (1927) Z. anorg. Chem., 164, 1-21, 34, 42.
 (1927) Z. anorg. Chem., 166, 67-77, 181.
- Menzel, H. and Gabler, C.**
 (1929) Z. anorg. Chem., 177, 187-98.
- Menzel, H. and Hagen, W.**
 (1937) Z. anorg. Chem., 233, 49-83, 209-35.
- Menzel, H. and Sieg, L.**
 (1932) Z. Elektrochem., 38, 287.
- Menzies, A. W. C.**
 (1936) J. Am. Chem. Soc., 58, 934-7.
- Menzies, A. W. C. and Dutt, N. N.**
 (1911) J. Am. Chem. Soc., 33, 1266.
- Menzies, A. W. C. and Humphrey, E. C.**
 (1912) 8th Int. Congr. Appl. Chem., 2, 175-8.
- Menzies, A. W. C. and Potter, P. D.**
 (1912) J. Am. Chem. Soc., 34, 1452.
- Menzies, R. C. and Walker, A. R. P.**
 (1936) J. Chem. Soc. (Lond.), 1678-85.
- Mercier, Jean-Marie.**
 (1937) Compt. rend., 204, 500.
- Merz and Muhlhauser.**
 (1870) Ber., 3, 710.
- Mescherski.**
 (1882) Z. anal. Chem., 21, 399.
- Metler, V.**
 (1934) J. Am. Chem. Soc., 56, 1509-10.
- Metler, V. and Vosburgh, W. C.**
 (1933) J. Am. Chem. Soc., 55, 2625-9.
- Metschl, J.**
 (1924) J. Phys. Chem., 28, 417-37.
- Metzner.**
 (1894) Compt. rend., 119, 683.
- van Meurs, C. J.**
 (1916) Z. physik. Chem., 91, 313-46.
- Meusser, A.**
 (1901) Ber., 34, 2435.
 (1902) Ber., 35, 1303, 1422.
 (1905) Z. anorg. Chem., 44, 80.
- Meyer, G.**
 (1924) Rec. trav. chim., 43, 397-8.
- Meyer, Hans von, Brod, L. and Soyka, W.**
 (1913) Monatsh. Chem., 34, 1125.
- Meyer, J.**
 (1909) Z. Elektrochem., 15, 266.
 (1911) Ber., 44, 2969.
 (1923) Rec. trav. chim., 42, 614-9.
- Meyer, Julius and Aulich, N.**
 (1928) Z. anorg. Chem., 172, 321-43.
- Meyer, Julius and Friedrich, W.**
 (1922) Z. physik. Chem., 101, 499.
 (1922a) Z. physik. Chem., 102, 369-87.
- Meyer, J. and Hinke, W.**
 (1932) Z. anorg. Chem., 204, 30.
- Meyer, J. and Kittlemann, C.**
 (1931) Z. anorg. Chem., 195, 121-6.
- Meyer, J. and Stateczny, V.**
 (1922) Z. anorg. allgem. Chem., 122, 1-21.
- Meyer, J. and Wilk, H.**
 (1924) Z. anorg. allgem. Chem., 132, 239-59.
- Meyer, K. H. and Dunkel, M.**
 (1931) Z. physik. Chem. (Bodenstein Festb.), 556.
- Meyer, R. J.**
 (1914) Z. anorg. Chem., 86, 285.
- Meyer, R. J. and Müller, U.**
 (1920) Z. anorg. allgem. Chem., 109, 15.
- Meyer, R. J. and Nachod, H.**
 (1924) Ann., 440, 186-99.
- Meyer, Victor.**
 (1875) Ber., 8, 998.
- Meyerhoffer, W.**
 (1890) Z. physik. Chem., 5, 102.
 (1904) Landolt and Börnstein "Tabellen," 4th Ed., 1912, p. 486.
 (1905) Z. physik. Chem., 53, 513-603.
 (1912) Landolt and Börnstein "Tabellen," 4th Ed., p. 481.
- Meyerhoffer, W. and Saunders.**
 (1899) Z. physik. Chem., 28, 466; 31, 382.
- Michael, Arthur.**
 (1901) Ber., 34, 3641, 3656.
- Michael, Arthur and Garner, W. W.**
 (1903) Ber., 36, 904.
- Michel and Kraft.**
 (1854) Ann. chim. phys., [3], 41, 471.
 (1858) Ann. chim. phys., [3], 41, 478.

AUTHOR INDEX

- Mickwitz, A.
 (1928) Z.anorg.Chem., 171, 285, 306.
 (1928) Z.anorg.Chem., 176, 277.
 (1931) Z.anorg.Chem., 196, 113.
- Miczynski, Z. N.
 (1886) Monatsh.Chem., 7, 255-72.
- Middleberg, W.
 (1903) Z.physik.Chem., 43, 305-53.
- Milbauer, J.
 (1912-13) J.prakt.Chem., [2], 87, 398.
 (1936) Bull.soc.chim. (France), [5], 3, 221-4.
- Miles, F. D. and Fenton, J.
 (1920) J.Chem.Soc., 117, 59-61.
- Miles, F. T. and Menzies, A. W. C.
 (1937) J.Am.Chem.Soc., 56, 2392-5.
- Millikan, J.
 (1917) Z.physik.Chem., 92, 59-80.
 (1918) Z.physik.Chem., 92, 496-510.
- Millikau, J.
 (1916) Z.physik.Chem., 92, 59-80.
- Miller, C.
 (1928) J.Chem.Soc. (Lond.), 1847.
- Miller, L. B. and Witt, J. C.
 (1929) J.Phys.Chem., 33, 285-9.
- Millett, H. and Jowett, M.
 (1929) J.Am.Chem.Soc., 51, 997-1004.
- Millican, Ida L., Joseph, A. F. and Lowry, T. M.
 (1922) J.Chem.Soc., [2], 959-63.
- Mills, R. V. and Wells, R. C.
 (1918) Bull.U.S.Geol.Survey, No. 693, p. 72.
- Miloslawski, S. I.
 (1931) Zhur.Obs.Khimii, 1, 900-4.
- Misciatelli, P.
 (1929) Phil.Mag., [7], 7, 670.
 (1930) Gazz.chim.ital., 60, 833-8.
- Missenden, J.
 (1922) Chem.News, 124, 326.
- Mitchell, A. E.
 (1923) J.Chem.Soc., 123, 1887-1904.
- Mitscherlich.
 (1832) Pogg.Ann., 25, 301.
- Miyaka, S.
 (1924) J.Chem.Ind.Japan, 27, 735-41.
 (1925) Mem.Coll.Eng.Kyushu, Imp. Univ., 3, 187-93.
- Moesveld, A. L. Th.
 (1919) Z.physik.Chem., 93, 402.
- Moissan, H.
 (1882) Bull.soc.chim., [2], 37, 296.
 (1885) Ann.chim.phys., [6], 4, 136.
- Moissan, H. and Siemens, F.
 (1904) Compt.rend., 138, 657, 1300.
 (1904) Bull.soc.chim., [3], 31, 1010.
 (1904) Ber., 37, 2088.
- Moles, E. and Carlota, R. de R.
 (1936) Anales Soc.Esp.fis.quim., 34, 331-62.
- Moles, E. and Gonzalez, F.
 (1923) Anales soc.espanola fis.quim., 21, 204-12.
- Moles, E. and Jimeno, E.
 (1915) Archiv.sci.phys.naturelles, [4], 40, 536.
- Moles, E. and Marquina, M.
 (1914) Anales soc.espanola fis.quim., 12, 383-93.
 (1924) Anales soc.espanola fis.quim., 22, 551-4.
- Moles, E. and Perez-Vitorlo, A.
 (1931) Z.physik.Chem. (Bodenstein Festb.) 583-90.
 (1932) Anales Soc.esp.fis.quim., 30, 200-7.
- Moles, E. and Portillo, R.
 (1924) Anales soc.espanola fis.quim., 22, 133.
- Mollier.
 (1908) Z.Ver.dent. Ing., 52, 2, 1315.
- Mondain-Monval, P.
 (1922) Compt.rend., 174, 1014.
 (1922) Compt.rend., 175, 162.
 (1923) Compt.rend., 177, 175.
 (1923) Compt.rend., 176, 301-4.
- Mondain-Monval, P. and Schneider, P.
 (1928) Bull.Soc.chim. (France), 43, 1302.
- Monèy, R. W. and Davies, C. W.
 (1934) J.Chem.Soc. (Lond.), 400-3.
 (1938) J.Chem.Soc. (Lond.), 2098-2100.

AUTHOR INDEX

Mönkemeyer.

(1906) N. Jahrb. Min. Geol. (Beil. Bd.),
22, 1.

Montemartini, G. and Losana, L.

(1928) L'Industria Chimica, 4, 107, 199,
291.

Moody, G. T. and Leyson, L. F.

(1908) J. Chem. Soc. (Lond.), 93, 1767.

Moore, B., Wilson, F. P. and Hutchinson, L.

(1909) Biochem. Jour., 4, 347.

Moore, T. S. and Winmill, T. F.

(1912) J. Chem. Soc. (Lond.), 101, 1662.

Morey, Geo. W.

(1917) J. Am. Chem. Soc., 39, 1173-1220.

Morgan, J. C. and James, C.

(1914) J. Am. Chem. Soc., 36, 10-16.

Morgan, J. L. R. and Pyne, H. R.

(1930) J. Phys. Chem., 34, 1578-82,
2045-8.

Morgan, J. L. R. and Richardson, A. H.

(1930) J. Phys. Chem., 34, 2356-66.

Mori, J.

(1923) J. Chem. Soc. Japan, 44, 730-8.

Morrell, R. S.

(1918) J. Chem. Soc., 113, 111-24.

Morris, T. C.

(1932) Ind. Eng. Chem., 24, 584-7.

Morse, H.

(1902) Z. physik. Chem., 41, 708-34.

Moser, L.

(1909) Z. anorg. Chem., 61, 384.

Moser, L. and Behr, M.

(1924) Z. anorg. allgem. Chem., 134,
49-53.

Moser, L. and Bruke, A.

(1926) Monatsh., Chem., 47, 711.

Moser, L. and Hackhofer, H.

(1932) Monatshefte Chem., 59, 44-51.

Moser, L. and Ritschel, E.

(1925) Monatsh., 46, 9-22.

Moufgang, E.

(1911) Wochschr. Brau., 28, 434-6.

(1911) J. Soc. Chem. Ind., 30, 1210.

Mougnard, P.

(1911) Compt. rend., 192, 1733-5.

Mousseron, M. and Gravier, P.

(1932) Bull. soc. chim. (France), 51,
1382-7.

Muchin, G.

(1913) "Solubility of Calcium Iodide
in Organic Solvents," Pamphlet,
45pp. and 12 charts, Kharkoff,
1913. (Reprint in the Russian
language received from author.)
See also Trav. sco. sci. physic.
Chem. Univ. Kharkoff 39 fasc.,
24, 1-49, 1913.

Muir.

(1876) J. Chem. Soc. (Lond.), 29, 857.

Mulder, G. J.

(1864) Scheikundige Verhandelingen
en Onderzoekingen, Vol. 3,
Pt. 2, Bijdragen tot de
Geschiedenis van Het
Scherkundig Gebonden
Water, Rotterdam, 1864.

Mueller, P. and Abegg, R.

(1906) Z. physik. Chem., 57, 514.

Müller, C.

(1910) N. Jahrb. Min. Geol. (Beil. Bd.),
30, 1.

(1912-13) Z. physik. Chem., 81, 483-503.

Müller.

(1887) Compt. rend., 104, 992.

(1889) Wied. Ann. Physik., [21], 37, 29.

(1892) Ann. chim. phys., [6], 27, 409.

Müller, Erich.

(1920) Z. angew. Chem., 33, 303.

(1923) Z. physik. Chem., 105, 73-118.

(1924) Z. physik. Chem., 110, 363-83.

(1924a) Z. physik. Chem., 114, 129-56.

Müller, E., Müller, J. and Fauvel, A.

(1927) Z. Elektrochem., 33, 134-44.

Müller, Ilse.

(1916) Z. anorg. allgem. Chem., 96, 29-63.

Müller, J. H.

(1922) J. Am. Chem. Soc., 44, 2496.

Müller, J. H. and Gulezian, C. E.

(1929) J. Am. Chem. Soc., 51, 2029.

Müller, J. M.

(1926-27) Proc. Am. Phil. Soc., 65, 44, 193.

Müller, J. M. and Blank, H. R.

(1924) J. Am. Chem. Soc., 46, 2358.

AUTHOR INDEX

- Müller, H.**
(1912) J.Chem.Soc. (Lond.), 101, 2400.
- Muller, H.**
(1933) Compt. rend., 196, 1109-11.
- Müller, R., Pinter, E. and Prett, K.**
(1925) Monatshefte Chem., 45, 525.
- Müller, R., Raschka and Wittmann.**
(1927-28) Monatshefte Chem., 48, 660.
- Müller, Robert.**
(1924-25) Z.anorg.allgem.Chem., 142, 130-2.
(1932) Z.Elektrochem., 38, 450.
(1932a) Z.Elektrochem., 38, 227-32.
- Mumford, S. A. and Gilbert, L. F.**
(1923) J.Chem.Soc., 123, 471-5.
- Munzberg, F.**
(1928) Lotos (Prague), 76, 351.
- Murata, K.**
(1932) J.Soc.Chem.Ind. (Japan), Suppl. 35, 523B.
- Murray, A. G.**
(1929) J.Assoc.Offic.Agr.Chemists. 12, 309.
- Muthmann and Kuntze.**
(1894) Z.Kryst.Min., 23, 368.
- Muthmann and Rölig.**
(1898) Z.anorg.Chem., 16, 455.
(1898) Ber., 31, 1728.
- Mylius, F.**
(1901) Ber., 34, 2208.
(1911) Ber., 44, 1315.
(1911) Z.anorg.Chem., 70, 209.
- Mylius, F. and Funk, R.**
(1897) Ber., 30, 1718.
(1900) Wiss.Abh.p.t.Reichsanstalt, 3, 451.
- Mylius, F. and von Wrochem, J.**
(1900) Wiss.Abh.p.t.Reichsanstalt, 3, 462.
(1900) Ber., 33, 3689.
- Nacken, R.**
(1907a) Nachr.kgl.Ges.Wissenschaft (Göttingen), 602.
(1907b) Jahrb.Min.Geol. (Beil.Bd.), 24, 1.
(1907c) Zentralbl.Min.Geol., 262, 301.
(1910) Sitzber.kgl.preuss.Akad.Wis., 1016-26.
- Nagorski, N. D. and Nowosselos, A. V.**
(1935) Zhur.Obs.Khimii, 5, 182-4.
- Nakatsuchi, A.**
(1930) J.Soc.Chem.Ind. (Japan), 33, 182.
- Naken, R. and Mosebach, R.**
(1936) Z.anorg.Chem., 228, 19-27.
- Nasini, R. and Ageno, I.**
(1910) Z.physik.Chem., 69, 482.
(1911) Gazz.chim.ital., 41, 1, 131.
- Nasu, N.**
(1933) Bull.Chem.Soc. (Japan), 8, 195-207, 392-9.
(1933) Sci.Reports.Tohoku Univ., 22, 972.
(1934) Bull.Chem.Soc. (Japan), 9, 201.
- Naude, S. M.**
(1927) Z.physik.Chem., 125, 98-110.
- Naumann, Alex.**
(1904) Ber., 37, 3600, 4328.
(1909) Ber., 42, 3789.
(1910) Ber., 43, 313.
(1914) Ber., 47, 1370.
- Naumann, Alex. and Rucker, A.**
(1905) Ber., 38, 2293.
- Naumann, Alex. and Schier, A.**
(1914) Ber., 47, 249.
- Neal, J. L. Jr., and McCrosky, C. R.**
(1938) J.Am.Chem.Soc., 60, 911-4.
- Neale, S. M. and Stringfellow, S. A.**
(1932) Trans.Faraday Soc., 28, 765-6.
- Neave, G. B.**
(1912) Analyst., 37, 399.
- Neckers, J. W. and Kremers, H. C.**
(1928) J.Am.Chem.Soc., 50, 950-4.
- Negishi, G. R., Donnally, L. H. and Hildebrand, J. H.**
(1933) J.Am.Chem.Soc., 55, 4793-4800.
- Nelson, O. A. and Haring, M. M.**
(1937) J.Am.Chem.Soc., 59, 2216-23.
- Nernst, W.**
(1889) Z.physik.Chem., 4, 379.
(1891) Z.physik.Chem., 8, 110.
- Nesterow, W. J. and Petine, N. J.**
(1931) Zhur.Obs.Khimii, 1, 272-8.
- Neuhausen, B. S. and Patrick, W. A.**
(1921) J.Phys.Chem., 25, 693-720.

AUTHOR INDEX

- Neuman, B. and Domke, R.**
(1928) Z. Elektrochem., **34**, 136-53.
- Neuman, E. W.**
(1932) J. Am. Chem. Soc., **54**, 2195-2207.
(1933) J. Am. Chem. Soc., **55**, 879-884.
(1934) J. Am. Chem. Soc., **56**, 28.
- Newbery, Edgar.**
(1936) Trans. Electrochem. Soc., **69**, 611-28.
- Newth.**
(1900) J. Chem. Soc. (Lond.), **77**, 776.
- Nicol, S. W. J.**
(1891) Phil. Mag. (Lond.), [5], **31**, 369, 386.
- Nichols, E. L., Howes, H. L. et al.**
(1919) Pub. Carnegie Inst., **298**, 207-30.
- Nicolardot, P.**
(1919) Compt. rend., **169**, 335.
- von Niewentowski, S. and von Roszkowski, T.**
(1897) Z. physik. Chem., **22**, 146.
- Niggli, Paul.**
(1916) Z. anorg. allgem. Chem., **98**, 241-326.
(1919) Z. anorg. allgem. Chem., **106**, 126-42.
- Nijui, A. T.**
(1937) Zhur. Obs. Khimii, **7**, 1935-47.
- Nikitin, B. and Tomatscheff, P.**
(1933) Z. physik. Chem. (A), **167**, 260-72.
- Nikitina, E. A.**
(1933) Zhur. Obs. Khimii, **3**, 513-8.
- Nikolajew, W. M.**
(1926) J. Russ. Phys. Chem. Soc., **58**, 557.
- Nikolajew, V. I.**
(1927) J. Russ. Phys. Chem. Soc., **59**, 289.
(1928) J. Russ. Phys. Chem. Soc., **60**, 895.
(1929) Z. anorg. Chem., **181**, 249-79.
- Nikolajew, V. I. and Rawitch, M. I.**
(1931) Zhur. Obs. Khimii, **1**, 785-91.
- Nims, L. F. and Bonner, D.**
(1929) J. Phys. Chem., **33**, 586.
- Nishizawa, K.**
(1920) J. Chem. Ind. Tokyo, **23**, 25-43, 1015-26.
- Nishizawa, K. and Hachikama, Y.**
(1925) J. Soc. Chem. Ind. (Japan), **28**, 272.
(1927) J. Soc. Chem. Ind. (Japan), **30**, 435.
(1929) Z. Elektrochem., **35**, 385-92.
- Nobuyaki, Nasu, see Nasu, N.**
- Noddak, I. and Noddak, W.**
(1929) Z. anorg. Chem., **181**, 25.
(1931) Z. angew. Chem., **44**, 215.
(1933) Z. anorg. Chem., **215**, 167.
- Nordenskjold and Lindstrom.**
(1869) Pogg. Ann., **136**, 314.
- Northrop, J. H.**
(1929) J. Gen. Physiol., **12**, 435.
- Noss, F.**
(1912) Dissertation, Graz.
(1912) Landolt and Börnstein "Tabellen," 4th Ed., p. 467.
- Nowosselowa, A. V.**
(1931) Zhur. Obs. Khimii, **1**, 668-83.
(1934) Zhur. Obs. Khimii, **4**, 1206-10.
(1939) Zhur. Obs. Khimii, **9**, 1063-6.
- Nowosselowa, A. V., Bodaljova, N. V. and Guershtein, M. M.**
(1938) Zhur. Obs. Khimii, **8**, 732-7.
- Nowoselowa, A. V. and Nogorskaya, N. D.**
(1935) Bull. Soc. Chim. (France) [5], **2**, 967-71.
(1935) Zhur. Obs. Khimii, **5**, 1002-6.
- Noyes, A. A.**
(1890) Z. physik. Chem., **6**, 248.
(1892) Z. physik. Chem., **9**, 606, 623.
- Noyes, A. A. and Abbott, C. G.**
(1895) Z. physik. Chem., **16**, 130.
- Noyes, A. A. and Boggs, C. R.**
(1911) J. Am. Chem. Soc., **33**, 1650.
- Noyes, A. A. and Chapin, E. S.**
(1898) Z. physik. Chem., **27**, 443.
(1899) J. Am. Chem. Soc., **21**, 513.
- Noyes, A. A. and Clement.**
(1894) Z. physik. Chem., **13**, 413.
- Noyes, A. A. and Farrel, F. S.**
(1911) J. Am. Chem. Soc., **33**, 1654.

AUTHOR INDEX

- Noyes, A. A. and Hall, F. W.**
(1917) *J. Am. Chem. Soc.*, **39**, 2529.
- Noyes, A. A. and Kohr, D. A.**
(1902) *J. Am. Chem. Soc.*, **24**, 1144.
(1902-03) *Z. physik. Chem.*, **42**, 336-42.
- Noyes, A. A. and Sammet, G. V.**
(1903) *Z. physik. Chem.*, **43**, 526.
- Noyes, A. A. and Schwartz, D.**
(1898) *Z. physik. Chem.*, **27**, 279-84.
(1898) *J. Am. Chem. Soc.*, **20**, 744.
- Noyes, A. A. and Seidenslicker.**
(1898) *Z. physik. Chem.*, **27**, 359.
- Noyes, A. A. and Stewart, M. A.**
(1911) *J. Am. Chem. Soc.*, **33**, 1658.
- Noyes, A. A. and Whitcomb, W. H.**
(1905) *J. Am. Chem. Soc.*, **27**, 756.
- Nuka, P.**
(1929) *Z. anorg. Chem.*, **180**, 235.
- O'Brien, H. R. and Parker, W. L.**
(1922) *J. Biol. Chem.*, **50**, 289-300.
- Occleshaw, V. J.**
(1925) *J. Chem. Soc.*, **127**, 2598-2602.
(1931) *J. Chem. Soc. (Lond.)*, 55-60,
1436-8.
(1932) *J. Chem. Soc. (Lond.)*, 2404-10.
(1934) *J. Chem. Soc. (Lond.)*, 1892-5.
- O'Connor, E. A.**
(1924) *J. Chem. Soc. (Lond.)*, **125**, 1422-7.
(1927) *J. Chem. Soc. (Lond.)*, **130**, 2700-10.
- Ogawa, E.**
(1930) *J. Chem. Soc. (Japan)*, **51**, 4, 193.
- Oglesby, N. E.**
(1929) *J. Am. Chem. Soc.*, **51**, 2352-62.
- Okada, K.**
(1914) *Mem. Coll. Sci. (Kyoto)*, **1**, 95-103.
- Okazawa, T.**
(1920) *J. Tokyo Chem. Soc.*, **41**, 602-20.
- Olie, Jr., J.**
(1906) *Z. anorg. Chem.*, **51**, 29-70.
(1907) *Z. anorg. Chem.*, **53**, 273-80.
- Olivari, F.**
(1908) *Atti accad. Lincei*, **[5]**, **17**, **II**,
512, 584, 717.
(1909) *Atti accad. Lincei*, **[5]**, **18**, **II**,
96.
(1911) *Atti accad. Lincei*, **[5]**, **20**, **I**,
470-4.
(1912) *Atti accad. Lincei*, **[5]**, **21**, **I**,
718.
(1914) *Atti accad. Lincei*, **[5]**, **I**, **23**, 41.
- Oliveri-Mandala, E.**
(1920) *Gazz. chim. ital.*, **50**, **II**, 89-98,
(1921) *Gazz. chim. ital.*, **51**, **I**, 130-8.
(1926) *Gazz. chim. ital.*, **56**, 889-901.
- Oliveri-Mandala, E. and Angenica, A.**
(1920) *Gazz. chim. ital.*, **50**, **I**, 273-81.
- Olmer, L. J.**
(1924) *Bull. soc. chim.*, **[4]**, **35**, 333-9.
- Olsson, F.**
(1930) *Z. anorg. Chem.*, **187**, 313-20.
- O'Neill, L. and Partington, J. R.**
(1934) *Trans. Faraday Soc.*, **30**, 1134.
- Orcutt, F. S. and Seevers, M. H.**
(1936) *J. Biol. Chem.*, **117**, 501-7.
(1937) *J. Pharmacol.*, **59**, 206-10.
- Ordway.**
(1865) *Am. Jour. Sci.*, **[2]**, **40**, 173.
- Orloff.**
(1902) *J. Russ. Phys. Chem. Soc.*, **37**, 949.
- Osaka, Y.**
(1903-8) *Mem. Coll. Sci. Eng. (Kyoto)*,
1, 93, 265, 290.
(1909) *7th Int. Cong. Appl. Chem.*, **4A**, 308.
(1910) *Mem. Coll. Sci. Eng. (Kyoto)*, **2**,
21-35.
(1910) *Nature (London)*, **84**, 248.
(1910-11) *Mem. Coll. Sci. Eng. (Kyoto)*,
3, 58.
(1911) *J. Tok. Chem. Soc.*, **32**, 670.
- Osaka, Y. and Abe, R.**
(1911) *Mem. Coll. Sci. Eng. (Kyoto)*, **3**, 51-4.
(1911) *J. Tok. Chem. Soc.*, **32**, 446.

AUTHOR INDEX

- Osaka, Y. and Ando, K.**
(1921) Mem. Coll. Sci. Kyoto, Imp. Univ.,
5, 169-72.
(1924) Z. physik. Chem., 110, 786-98.
(1925-6) Mem. Coll. Sci. Kyoto, Imp. Univ.
Ser. A, 9, 81-95.
- Osaka, Y. and Hara, R.**
(1917) Mem. Coll. Sci. Kyoto, Imp. Univ.,
2, 147-50.
- Osaka, Y. and Inouye, R.**
(1925) Japan. J. Chem., 2, 87-98.
- Osaka, Y. and Nishio (Takesuye) H.**
(1930) Bull. Chem. Soc. (Japan), 5, 181-3.
- Osaka, Y., Shima, G. and Yoshida, R.**
(1924) Mem. Coll. Sci. Kyoto, Imp. Univ.
(A), 7, 69-75.
- Osaka, Y. and Yaginuma, T.**
(1927) Z. physik. Chem., 130, 480.
(1928) Bull. Chem. Soc., (Japan), 3, 4-10.
- Osaka, Y. and Yoshida, R.**
(1922) Mem. Coll. Sci. Kyoto, Imp. Univ.,
6, 49-54.
(1922) J. Chem. Soc. Japan, 43, No. 12.
- Osborg.**
(1926) Dipl. Arb. Braunschweig.
- Osipoff and Popoff.**
(1903) J. Russ. Phys. Chem. Soc., 35, 637.
- Ossendowski, A. M.**
(1907) Pharm. J. (Lond.), 79, 575.
(1907) J. pharm. chim., [6], 26, 162.
- Ost.**
(1878) J. prakt. Chem., [1], 17, 232.
- Oswald, M.**
(1914) Ann. chim., 1, 57-79.
(1912) Compt. rend., 155, 1504.
(1912) 8th Int. Cong. Appl. Chem., 2, 205.
- Ostersetzer, D.**
(1926) Roc. Z. Chem., 6, 679-89.
- Owen, B. B.**
(1933) J. Am. Chem. Soc., 55, 1922.
(1938) J. Am. Chem. Soc., 60, 2229-33.
- Padoa, M. and Tibaldi.**
(1903) Atti accad. Lincei, [5], 12, II, 160.
- Packer, J. and Rivett, A. C. D.**
(1926) J. Chem. Soc., 129, 1061-2.
- de Paeppe, Desire.**
(1911) Bull. soc. chim. Belg., 25, 174.
- Paie, M.**
(1930) Compt. rend., 191, 941, 1337.
(1933) Archiv. Hemiju Farm., 7, 161-9.
- Pajetta, R.**
(1906) Gazz. chim. ital., 36, II, 67, 155, 300.
(1907) Pharm. Jour. (Lond.), 79, 315.
- Palazzo and Batelli.**
(1883) Atti accad. sci. Torino, 19, 514.
- Palitzsch, Sven.**
(1928-29) Z. physik. Chem., (A), 138, 386-95.
(1929) Z. physik. Chem. (A), 145, 97-102.
- Palkin.**
(1926) J. Russ. Phys. Chem. Soc., 58, 1334-8.
(1928) J. Russ. Phys. Chem. Soc., 60, 317.
- Pallu, Rene.**
(1931) Compt. rend., 193, 109-11.
- Panfiloff.**
(1893) J. Russ. Phys. Chem. Soc., 25, 162.
(1893) Chem. Centralbl., 11, 910.
(1893a) J. Russ. Phys. Chem. Soc., 25, 262.
(1894) Z. anorg. Chem., 5, 490.
- Paris, R. and Mondain-Monval, P.**
(1938) Bull. soc. chim. (France), [5], 5, 1142.
- Parker, E. G.**
(1914) J. Phys. Chem., 18, 653.
- Parker, T. W. and Robinson, P. L.**
(1931) J. Chem. Soc. (Lond.), 1314-23.
- Parks, G. and Campanella, J. L.**
(1936) J. Phys. Chem., 40, 333-41.
- Parks, H., Patterson, M. and Vosburgh, W. C.**
(1937) J. Am. Chem. Soc., 56, 2141.
- Parks, W. G. and Moran, W. G.**
(1937) J. Phys. Chem., 41, 343-8.
- Parks, W. G. and Prime, G. E.**
(1936) J. Am. Chem. Soc., 58, 1413-4.
- Parmentier.**
(1887) Compt. rend., 104, 686.
(1892) Compt. rend., 114, 1002.
- Parravano, N.**
(1909) Gazz. chim. ital., 39, II, 58.
(1918) Gazz. chim. ital., 48, II, 123.
- Parravano, N. and Calcagni, G.**
(1908) Atti accad. Lincei, [5], 17, I,
731-8.
(1910) Z. anorg. Chem., 65, 1.

AUTHOR INDEX

- Parravano, N. and de Cesaris, P.**
 (1912) Atti accad. Lincei, [5], 21, I, 535.
 (1912a) Atti accad. Lincei, [5], 21, I, 800.
 (1912b) Gazz. chim. ital., 42, II, 1-191.
- Parravano, N. and Fornaini, M.**
 (1907) Gazz. chim. ital., 37, II, 521.
 (1907) Atti accad. Lincei, [5], 16, II, 465.
- Parravano, N. and Mieli, A.**
 (1908) Atti accad. Lincei, [5], 17, II, 33-4.
 (1908) Gazz. chim. ital., 38, II, 536.
- Pascal, P. and Ero.**
 (1919) Bull. soc. chim., [4], 25, 35-49.
- Pascal, P. and Garneir.**
 (1919) Bull. soc. chim., [4], 25, 314.
- Parsons, Chas. L. and Corliss, H. P.**
 (1910) J. Am. Chem. Soc., 32, 1367.
- Parsons, C. L. and Carson, H. P.**
 (1910) J. Am. Chem. Soc., 32, 1383.
- Parsons, C. L. and Perkins, C. L.**
 (1910) J. Am. Chem. Soc., 32, 1387.
- Parsons, C. L. and Whittemore, C. F.**
 (1911) J. Am. Chem. Soc., 33, 1933.
- Partheil and Ferie.**
 (1903) Archiv. Pharm., 241, 554.
- Partheil and Hübner.**
 (1903) Archiv. Pharm., 241, 413.
- Partington, J. R.**
 (1911) J. Chem. Soc. (Lond.), 99, 315.
- Partington, J. R. and Soper.**
 (1929) Phil. Mag., [7], 7, 209.
- Partington, J. R. and Stonehill, H. J.**
 (1936) Phil. Mag., [7], 22, 857-82.
- Partington, J. R. and Winterton, R. J.**
 (1934) Trans. Faraday Soc., 30, 619-26.
 (1934a) Trans. Faraday Soc., 30, 1104-5.
- Partridge, E. P. and White, A. H.**
 (1929) J. Am. Chem. Soc., 51, 360-70.
- Pascal, P.**
 (1909) Ann. chim. phys., [8], 16, 374.
 (1912) Bull. soc. chim., [4], 11, 323, 596, 1033.
 (1913) Bull. soc. chim., [4], 13, 746.
 (1914) Bull. soc. chim., [4], 15, 454.
 (1923) Bull. soc. chim. (France) [4], 33, 539.
- Pascal, P. and Garnier.**
 (1923) Compt. rend., 176, 450.
- Pascal, P. and Normand, L.**
 (1913) Bull. soc. chim., [4], 13, 154-202, 879.
- de Passille, A.**
 (1936) Ann. chim., [11], 5, 85-8.
- Patrick and Aubert.**
 (1874) Trans. Kansas Acad. Sci., 19.
- Patscheke, G.**
 (1933) Z. physik. Chem. (A), 163, 340-50.
- Patscheke, G. and Taune, C.**
 (1935) Z. physik. Chem. (A), 174, 135-55.
- Patten, H. E. and Mott, W. R.**
 (1904) J. Phys. Chem., 8, 153.
- Patterson, A. M.**
 (1906) J. Am. Chem. Soc., 28, 1734.
- Paul, Th.**
 (1894) Z. physik. Chem., 14, 111.
 (1896) Z. physik. Chem., 25, 95.
 (1901) Arch. Pharm., 239, 64.
 (1915) Z. Elektrochem., 21, 543.
 (1917) Z. Elektrochem., 23, 65-86.
 (1926) Arb. Reichsgesundh. Amt., 57, 94-114.
- Paul, Th., Ohlmüller, W., Heise, R. and Auerbach, Fr.**
 (1906) Arb. Kaiserl. Gesundheitsamt., 23, 333-88.
- Pauli, W. and Stenzinger, Th.**
 (1929) Biochem. Z., 205, 71-103.
- de Pauw, P. F. M.**
 (1922) These, Utrecht.
 (1926) "Tablelles Annuelles", 5, 929.
- Pawlewski, Br.**
 (1893) Anzeiger Akad. Wiss. Krakau, p. 379.
 (1898) Ber., 30, 2806.
 (1899) Ber., 32, 1040.
 (1900) Ber., 33, 1223.
- Pawlewski, Br. and Filemonowicz.**
 (1888) Ber., 21, 2973.
- Payen.**
 (1852) Compt. rend., 34, 356.
- Payne, J. H.**
 (1937) J. Am. Chem. Soc., 56, 947.

AUTHOR INDEX

- Pearce, G. W. and Norton, L. B.**
 (1936) J. Am. Chem. Soc., **58**, 1104-8.
 (1937) J. Am. Chem. Soc., **59**, 1258-61.
- Pearce, J. N. and Eversole, W. G.**
 (1924) J. Phys. Chem., **28**, 245-55.
- Pearce, J. N. and Fry, E. J.**
 (1914) J. Phys. Chem., **18**, 667.
- Pearce, J. N. and Moore, T. E.**
 (1913) Am. Chem. Soc., **50**, 218.
- Pearce, J. N. and O'Leary, J. V.**
 (1923) Proc. Iowa Acad. Sci., **30**,
 379-85.
- Pearson, T. G. and Robinson, P. L.**
 (1930) J. Chem. Soc. (Lond.), 1473-95.
 (1931) J. Chem. Soc. (Lond.), 413, 1304-13.
- Peddie, C. J. and Turner, W. E. S.**
 (1913) J. Chem. Soc. (Lond.), 103, 1205.
- Pedersen, Kai J.**
 (1939) J. Am. Chem. Soc., **61**, 334-6.
- Peiker, A. L. and Coffin, C. C.**
 (1933) Canadian J. Res., **8**, 114.
- Pelabon, H.**
 (1897) Compt. rend., **124**, 35.
 (1904) J. chim. phys., **2**, 320.
 (1907) Compt. rend., **145**, 118.
 (1908) Compt. rend., **146**, 975.
 (1909) Ann. chim. phys. [8], **17**, 526-66.
 (1913) Compt. rend., **156**, 705-7.
- Pelabon, H. and Laude, Mme.**
 (1928) Bull. Soc. chim. (France) [4], **45**,
 488-92.
- Pelling, A. J.**
 (1925) J. S. African Chem. Inst., **8**, 3-6.
- Pelling, A. J. and Robertson, J. B.**
 (1923) S. African J. Sci., **20**, 236-40.
- Pellini, G.**
 (1906a) Atti accad. Lincei [5], **15**, I,
 629.
 (1909) Atti accad. Lincei [5], **18**, I,
 703, II 21, 280.
- Pellini, G. and Pedrina, S.**
 (1908) Atti accad. Lincei, [5], **17**, II,
 78.
- Pellini, G. and Vio, G.**
 (1906) Atti accad. Lincei, [5], **15**, II,
 46-53.
- Pelouze.**
 (1869) Compt. rend., **68**, 1179; **69**, 56.
- van Pelt, A. J. Jr. and de Boer, F.**
 (1934) Z. physik. Chem. (A), **170**, 256-61.
- Peng Chung-Ming.**
 (1935) Bull. soc. chim. (France), [5], **2**,
 985-93.
- Penny.**
 (1855) Phil. Mag., **4**, **10**, 401.
- Perkin.**
 (1894) J. Chem. Soc. (Lond.), **65**, 27.
- Perman, E. P.**
 (1901) J. Chem. Soc. (Lond.), **79**, 718.
 (1902) J. Chem. Soc. (Lond.), **81**, 480.
 (1903) J. Chem. Soc. (Lond.), **83**, 1168.
 (1922) J. Chem. Soc., **121**, 2473-83.
- Perman, E. P. and Harrison, W. R.**
 (1924) J. Chem. Soc., **125**, 364-9.
 (1924a) J. Chem. Soc., **125**, 1709-13.
- Perman, E. P. and Howells, W. J.**
 (1923) J. Chem. Soc., **123**, 2128-34.
- Perman, E. P. and Saunders, H. L.**
 (1923) J. Chem. Soc., **123**, 841-9.
- Pernot, Mlle. M.**
 (1926) Compt. rend., **182**, 1154.
 (1927) Compt. rend., **185**, 950.
 (1929) Compt. rend., **188**, 635.
 (1929) Compt. rend., **189**, 325.
 (1931) These, Paris.
 (1931) Ann. chim., [10], **15**, 1-84.
 (1932) Compt. rend., **195**, 238.
 (1933) Compt. rend., **196**, 1314-16.
 (1934) Compt. rend., **199**, 478-80.
 (1936) Compt. rend., **202**, 576.
 (1938) Compt. rend., **206**, 909.
- Peterson, B. H. and Meyers, E. L.**
 (1930) J. Am. Chem. Soc., **52**, 4853-7.
- Pettersson, O. and Sonden, K.**
 (1889) Ber., **22**, 1439.
- Pfaundler and Schnegg.**
 (1875) Sitzber. k. Akad. Wis. (Wien),
71, II, 351.
- Pfeiffenberger, A. and Leimbach, G.**
 (1928) Caliche, **9**, 485.
- Pfeiffer, P. and Modelski, J. v.**
 (1912) Z. physiol. Chem., **81**, 331-3.

AUTHOR INDEX

- Piater, J.**
(1928) Z.anorg.chem., 174, 321-41.
- Pickering, S. U.**
(1890) J.Chem.Soc. (Lond.), 57, 331.
(1890-91) Proc.Roy.Soc. (Lond.), 49, 25.
(1893) J.Chem.Soc. (Lond.), 63, 141, 463, 909, 998.
(1893a) Ber., 26, 2307.
(1895) J.Chem.Soc. (Lond.), 67, 669.
(1912) Landolt and Börnstein, "Tabellen," 4th Ed., p.471.
(1915) J.Chem.Soc. (Lond.), 107, 942-54.
- Picon, M.**
(1924) Bull.soc.chim., [4], 35, 1093-1112.
(1931) Bull.soc.chim. (France) [4], 49, 399-423.
(1931) J.pharm.chim. [8], 13, 185-95, 233-43.
(1934) Bull.soc.chim. (France), [5], 1, 926-34.
- Pictet, Raoul.**
(1894) Compt.rend., 119, 642.
- Pierrat, M.**
(1921) Compt.rend., 172, 1041-3.
- Pierre.**
(1847) J.pharm.chim., [3], 12, 237.
- Pina de Rubies, S.**
(1913) Anales soc.espan.fis.quin., 11, 422-35.
(1914) Anales soc.espan.fis.quin., 12, 343-9.
(1914) Archiv.sci.physique, naturelle (Madrid), [4], 38, 414-22.
(1915) Chem.Zentralbl., I, 521.
- Pink, R. C.**
(1938) J.Chem.soc. (Lond.), 53-5.
- Pinkus, A. and Berkolaiko, N.**
(1930) J.Chim.phys., 27, 364-85.
- Pinkus, A., Frederic, Mlle. S. and Schepmans, R.**
(1938) Bull.soc.chim(Belg.), 47, 304-36.
- Pinkus, A. and Haugen, M.**
(1936) Bull.soc.chim. (Belg.), 45, 693-716.
- Pinkus, A. and Haurez, P.**
(1938) Bull.soc.chim. (Belg.), 47, 532-74.
- Pinkus, A. and Jacobi.**
(1927) Bull.soc.chim. (Belg.), 36, 464.
- Pinkus, A. and Martin, F.**
(1927) Jour.chim.phys., 24, 83-102, 137-68.
- Pinkus, A. and Shepmans, R.**
(1938) Bull.soc.chim.Belg., 337-61.
- Pinkus, A. and Timmermans, Mlle. A. M.**
(1937) Bull.soc.chim. (Belg.), 46, 46-73.
- Plato.**
(1907) Z.physik.Chem., 58, 350.
- Platt, J. H. and Hudson, D.**
(1926) J.Soc.Dyers & Colourists, 42, 348.
- Pleissner, M.**
(1907) Arb.Kais.Gesundheitsamt, 26, 384-443.
- Ploinowna, A.**
(1926) Roczniki chem., 6, 690-9.
- Plotnikow, W. A.**
(1911) Ann.inst.Polytech.Kiev., 11, 310.
(1915) J.Russ.Phys.Chem.Soc., 47, 1062-4.
- Plotnikow, W. A. and Iwanow, K. N.**
(1931) Zhur.Obs.Khimii, 1, 823-5.
- Poggiale.**
(1843) Ann.chim.phys., [3], 8, 467.
- Pohl.**
(1852) J.prakt.Chem., 56, 216.
(1860) Sitzber.k.Akad.Wiss. (Wien), 41, 627.
- Pollacci.**
(1896) L'Orosi, 19, 217.
- Polessitsky, A.**
(1932) Z.physik.Chem. (A), 161, 325-35.
(1933) Z.physik.Chem. (A), 167, 394-8.
(1935) Z.physik.Chem. (A), 172, 300-3.
- Pollitzer, F.**
(1909) Z.anorg.Chem., 64, 121-48.

AUTHOR INDEX

- Poma, G.**
 (1909) Atti accad. Lincei, [5], 18, 1, 133-8.
 (1910) Gazz. chim. ital., 40, 1, 197.
- Poma, G. and Gabbi, G.**
 (1912) Gazz. chim. ital., 42, 11, 8.
 (1911) Atti accad. Lincei, [5], 20, 1, 464-70.
- Ponomarev, I. F.**
 (1917) J. Russ. Phys. Chem. Soc., 49, 29-40.
 (1921) Soobschenija man. techn. rabot sch. Respublike, Moskow, 67-71.
- Popoff, Stephen and Newman, E. W.**
 (1930) J. Phys. Chem., 34, 1853-60.
- Porlezza, C.**
 (1914) Atti accad. Lincei, [5], 23, 11, 509, 597.
- Portillo, R.**
 (1929) Anales Soc. Esp. fis. quim., 27, 236-50, 351-7.
- Portillo, R. and Alberola, L.**
 (1930) Anales Soc. Esp. fis. quim., 28, 1187.
- Portnow, M. A. and Dwilewitch, N. K.**
 (1937) Zhur. Obs. Khimii, 7, 2149-53.
- Portnow, M. A. and Rawdine, J. A.**
 (1937) Zhur. Obs. Khimii, 7, 2478-85.
- Portnow, M. A. and Schurawlew, A. W.**
 (1935) Z. anorg. Chem., 223, 45-8.
- Portnow, M. A. and Wassilew, B. B.**
 (1935) Z. anorg. Chem., 221, 149-53.
- Posnjak, E. and Merwin, H. E.**
 (1922) J. Am. Chem. Soc., 44, 1965-94.
- Posnjak, E. and Tunell, G.**
 (1929) Am. J. Sci., 18, 1.
- Postma, S.**
 (1920) Rec. trav. chim., 39, 515-36.
- Power, F. B. and Tutin.**
 (1905) J. Chem. Soc. (Lond.), 87, 24.
- Prandtl, W. and Ducrue, H.**
 (1926) Z. anorg. allgem. Chem., 150, 105-16.
- Prandtl, W. and Rauchenberger, J.**
 (1920) Ber., 53B, 843-53.
- Pratolongo, U.**
 (1916) Ann. chim. applicata, 6, 59-112.
 (1925) Atti accad. Lincei., [6], 1, 238-43.
 (1913) Atti accad. Lincei [5], 22, 1, 388.
- Precht, H. and Wittgen, B.**
 (1881) Ber., 14, 1667.
 (1882) Ber., 15, 1666.
- Presse, C. H.**
 (1874) Ber., 7, 599.
- Prideaux, E. B. R. and Millott, J. O.**
 (1929) J. Chem. Soc. (Lond.), 2703-9.
- Prociv, D.**
 (1929) Coll. Czechoslov. Chem. Com., 1, 95.
- Prupton, C. F., Brosheer, J. C. and Maron, S. H.**
 (1935) J. Am. Chem. Soc., 57, 1656-7.
- Prupton, C. F. and Tower, O. F.**
 (1932) J. Am. Chem. Soc., 54, 3040-7.
- Puckner, W. A. and Hilpert, W. S.**
 (1909) J. Am. Med. Assoc., 52, 311.
- Pugh, W.**
 (1926) J. Chem. Soc. (Lond.), 2828.
 (1929) J. Chem. Soc. (Lond.), 1537-41.
 (1932) Trans. Roy. Soc. S. Africa, 21, 67.
- Purcell, R. H. and Cheesman, G. H.**
 (1932) J. Chem. Soc. (Lond.), 826-34.
- Purdum, R. B. and Rutherford, H. A. Jr.**
 (1933) J. Am. Chem. Soc., 55, 322-3.
- Puschin, N. A. and Baskow, A.**
 (1913) Z. anorg. Chem., 81, 347-63.
- Puschin, N. A. and Delzelic, M.**
 (1932) Monatshefte. Chem., 60, 431-7.
- Puschin, N. A. and Hrustanovic, K. S.**
 (1938) Ber., 71, 798-801.
- Puschin, N. A. and Kovac, D.**
 (1931) Z. anorg. Chem., 199, 369-73.
- Puschin, N. A. and Kriger, J.**
 (1914) J. Russ. Phys. Chem. Soc., 46, 559.
- Puschin, N. A. and Lowy, S.**
 (1926) Z. anorg. Chem., 150, 167.
- Puschin, N. A. and Makuc, J.**
 (1938) Z. anorg. Chem., 237, 177-82.
- Puschin, N. A. and Radoicic, M.**
 (1937) Z. anorg. Chem., 233, 41-46.
- Quam, G. N.**
 (1929) Ind. Eng. Chem., 21, 703.

AUTHOR INDEX

- Quartarolli, A.**
(1920) Gazz.chim.ital., 50, II, 67.
- Queisner.**
(1921) Mitt. Kalifornische Inst., 75.
- Quercigh, E.**
(1912) Atti accad. (Lincei), [5], 21, 1, 417, 786.
(1914) Atti accad. (Lincei), [5], 23, 1, 449, 825.
- Quill, L. L. and Robey, R. F.**
(1937) J. Am. Chem. Soc., 59, 1071, 2591-5.
- Quinet, L.**
(1935) Bull. soc. chim. (France) [5], 2, 1201-5.
- Quinn, E. L.**
(1928) J. Am. Chem. Soc., 50, 672-81.
- Rabe, W. O.**
(1901) Z. physik. Chem., 38, 175-84.
(1902) Z. anorg. Chem., 31, 156.
- Rabinowitsch, M. and Jakobsohn, S.**
(1923) Z. anorg. allgem. Chem., 129, 55-9.
- Rack, G.**
(1914) Centr. Min. Geol., 326-8.
- Radan.**
(1889) Liebig's Ann., 251, 129.
- Radiscev, V. P.**
(1928) J. soc. chim. Russe, 60, 322.
- Raditschew.**
(1930) Zhur. fiziko-chemic Obsc., 62, 1063.
- Raeder, M. G.**
(1927) Z. anorg. Chem., 162, 222-30.
(1933) Z. anorg. Chem., 210, 156.
- Raffo, M. and Rossi, G.**
(1915) Gazz. chim. ital., 45, I, 45.
- Rakowski, A. W. and Babajewa, A. W.**
(1931) U. S. S. R. Sci. Res. Dept. Sup. Council Nat. Econ., No. 420. Trans. Inst. Pure Chem. Rec. No. 11, 15.
- Rakowski, A. W. and Nikitina, E. A.**
(1931) U. S. S. R. Sci. Research Dept. Sup. Council Nat. Economy, No. 420, 5. Trans. Inst. Pure Chem. Reagents No. 11, 51.
- Rakowski, A. W. and Polanski, V. V.**
(1927) U. S. S. R. Trans. Inst. Pure Chem. Reagents. No. 6, 7.
- Rakowski, A. W. and Slavina, D. S.**
(1931) Trans. Inst. Pure Chem. Reagents, No. 11, 20.
- Rakowski, A. W. and Tarassenkow, D. N.**
(1928) Z. anorg. Chem., 174, 91.
- Ramann, E. and Sallinger, H.**
(1921) Z. physik. Chem., 98, 103-50.
- Rammelsberg.**
(1838) Pogg. Ann., 43, 665; 44, 575.
(1841) Pogg. Ann., 52, 81, 96.
(1892) J. prakt. Chem., [2], 45, 153.
- Ramstedt, Eva.**
(1911) Radium, 8, 253-6.
- Randall, Merle and Halford, J. O.**
(1930) J. Am. Chem. Soc., 52, 178-91.
- Randall, M. and Spencer, H. M.**
(1928) J. Am. Chem. Soc., 50, 1572-83.
- Randall, M. and Vietti, W. V. A.**
(1928) J. Am. Chem. Soc., 50, 1526-34.
- Rankin, G. A. and Merwin, H. E.**
(1916) Z. anorg. allgem. Chem., 96, 291-316.
(1916) J. Am. Chem. Soc., 38, 568.
- Rankin, G. A. and Wright.**
(1915) Am. Jour. Sci., [4], 39, 1-79.
- Raoult.**
(1874) Ann. chim., [5], I, 262.
- Raupenstrauch, G. A.**
(1885) Monatsh. Chem., 6, 585.
- Ravitz, S. F.**
(1936) J. Phys. Chem., 40, 61-70.
- Ray, R. C. and Chatterji, K. K.**
(1932) J. Chem. Soc., 384-6.
- Ray, R. C. and Nitra, H. C.**
(1934) Trans. Faraday Soc., 30, 1161-3.
(1935) Trans. Faraday Soc., 31, 1312-4.
- Ray, P. C. and Sarkar, P. V.**
(1922) J. Chem. Soc., 121, 1449-55.
- Rebiere, G.**
(1915) Bull. soc. chim., [4], 17, 268, 309.
- Reburn, W. T. and Shearer, W. N.**
(1933) J. Am. Chem. Soc., 55, 1774-9.
- Redfield, H. L. and King, G. B.**
(1936) J. Phys. Chem., 40, 919-25.
- Reed, R. M. and Tartar, H. V.**
(1936) J. Am. Chem. Soc., 58, 322-32.

AUTHOR INDEX

- Reedy, J. H.
(1921) J. Am. Chem. Soc., 43, 1443.
- Rees, A. G. and Huddleston, L. J.
(1931) J. Chem. Soc. (Lond.), 1648-52.
- Reich.
(1891) Monatsh. Chem., 12, 464.
- Reicher, L. T. and van Deventer, C. M.
(1890) Z. physik. Chem., 5, 560.
- Reichstein, S., Ewentow, L. and Kasarnowsky, I.
(1933) Z. anorg. Chem., 216, 1-9.
- Reid.
(1887-88) Proc. Roy. Soc. (Edin.), 15, 151.
- Reid, H. S. and McIntosh, D.
(1916) J. Am. Chem. Soc., 38, 615-25.
- Reiff, F. and Toussaint, S. M.
(1939) Z. anorg. Chem., 241, 372-80.
- Reinders, W.
(1900) Z. physik. Chem., 32, 494, 514.
(1906) Z. physik. Chem., 54, 609.
(1914) Proc. k. Akad. Wet. (Amst.), 16, 1065.
(1915) Z. anorg. Chem., 93, 202.
- Reinders, W. and Van Gelder, D. W.
(1932) Rec. trav. chim., 51, 253-9.
- Reinders, M. and Khinkenbergh, A.
(1929) Rec. trav. chim., 48, 1227-64.
- Reinders, W. and de Lange, S.
(1912-13) Z. anorg. Chem., 79, 230.
(1912) Proc. k. Akad. Wet. (Amst.), 15, 474.
- Reinitzer, D.
(1913) Z. angew. Chem., 26, 456.
- Reissig.
(1863) Liebig's Ann., 127, 33.
- Remy, H.
(1925) Z. Elektrochem., 31, 92.
- Remy, H. and Kuhlmann, A.
(1924) Z. anal. Chem., 65, 1-24, 161-81.
- Rengade, E.
(1917) Rev. gen. sci., 28, 489.
(1922) Chim. et Indust., 7, 1090-8.
- Restanio, di S.
(1934) Atti accad. Lincei [6], 20, 192-200.
- Retgers, J. W.
(1893) Z. anorg. Chem., 3, 253, 344.
(1893) Rec. trav. chim., 12, 229.
- Retortillo, N. M. and Moles, E.
(1933) Anales Soc. Esp. fis. quim., 31, 830-9.
- Rex.
(1906) Z. physik. Chem., 55, 355.
- Reychler, A.
(1910) J. chim. phys., 8, 618.
- Reynolds, J. E. and Werner, E. A.
(1903) J. Chem. Soc. (Lond.), 83, 5.
- Rheinboldt, H. and Schneider, K.
(1929) J. prakt. Chem., 120, 240.
- Rhodes, F. H. and Bascom, C. H.
(1927) Ind. Eng. Chem., 19, 480-1.
- Rhodes, F. H. and Lewis, A. W.
(1928) Ind. Eng. Chem., 20, 1366-7.
- Ricci, J. E.
(1934) J. Am. Chem. Soc., 56, 290-303.
(1935) J. Am. Chem. Soc., 57, 805-10.
(1936) J. Am. Chem. Soc., 58, 1077-9.
(1937) J. Am. Chem. Soc., 59, 866-9, 1763.
(1938) J. Am. Chem. Soc., 60, 2040-3.
- Ricci, J. E., Budish, J. and Borodulia, N.
(1937) J. Am. Chem. Soc., 59, 868-9.
- Ricci, J. E. and Yanick, N. S.
(1936) J. Am. Chem. Soc., 58, 313-5.
(1937) J. Am. Chem. Soc., 59, 491-6.
- Richard, F.
(1926) J. pharm. chim., [8], 4, 306.
- Richards, T. W.
(1897) Z. anorg. Chem., 3, 455.
- Richards, T. W. and Archibald, E. H.
(1901-02) Proc. Am. Acad., 37, 345.
(1902) Z. physik. Chem., 40, 385-98.
- Richards, T. W. and Churchill.
(1899) Z. physik. Chem., 28, 314.
- Richards, T. W. and Faber, H. B.
(1899) Am. Chem. Jour., 21, 167-72.
- Richards, T. W. and Kelley.
(1911) J. Am. Chem. Soc., 33, 847.
- Richards, T. W., McCaffrey and Bisbee.
(1901) Z. anorg. Chem., 28, 85.
- Richards, T. W. and Meldrum, W. B.
(1917) J. Am. Chem. Soc., 39, 1821-2.

AUTHOR INDEX

- Richards, T. W. and Schumb, W. C.
(1918) J. Am. Chem. Soc., 40, 1403-9.
- Richards, T. W. and Yngve, V.
(1918) J. Am. Chem. Soc., 40, 164-74.
- Richert, P. H.
(1930) J. Am. Chem. Soc., 52, 2241-4.
- Riesenfeld, E. H.
(1902) Z. physik. Chem., 41, 346.
(1903) Z. physik. Chem., 45, 461.
- Riesenfeld, E. H. and Feld, H.
(1921) Z. anorg. allgem. Chem., 116, 213-27.
- Riley, W. A.
(1911) Jour. Inst. Brewing, 17, 124.
(1911) Tables annuelles, 2, 428.
- Rimbach, E.
(1897) Ber., 30, 3079.
(1902) Ber., 35, 1300.
(1904) Ber., 37, 463.
(1905) Ber., 38, 1553-7, 1570.
- Rimbach, E. and Fleck, K.
(1916) Z. anorg. Chem., 94, 139-56.
- Rimbach, E. and Korten, F.
(1907) Z. anorg. Chem., 52, 407.
- Rimbach, E. and Schubert, A.
(1909) Z. physik. Chem., 67, 183-200.
- Rindell, A.
(1902) Compt. rend., 134, 112.
(1910) Z. physik. Chem., 70, 452-8.
- Ringer, W. E.
(1902) Z. anorg. Chem., 32, 212.
(1902) Rec. trav. chim., 21, 374.
- Ritzel, A.
(1911) Z. Kryst. Min., 49, 152.
- Rivett, A. C. D.
(1922) J. Chem. Soc., 121, 379-93.
(1926) J. Chem. Soc., 129, 1063-70.
- Rivett, A. C. D. and Clendinnen, F. W. J.
(1923) J. Chem. Soc., 123, 1634-40.
- Rivett, A. C. D. and Lewis, N. B.
(1923) Rec. trav. chim., 42, 954-63.
- Rivett, A. C. D. and O'Conner, E. A.
(1919) J. Chem. Soc., 115, 1346-54.
- Rivett, A. C. D. and Packer, J.
(1927) J. Chem. Soc. (Lond.), 130, 1342-9.
- Robertson, J. B.
(1924) J. Soc. Chem. Ind., 43, 334-8.
(1933) S. African, J. Sci., 30, 187.
- Robertson, P. W.
(1907) Chem. News, 95, 253.
- Robinet.
(1864) Compt. rend., 58, 608.
- Robinson, A. F.
(1928) J. Phys. Chem., 32, 1089-93.
- Robinson, F. W.
(1909) J. Chem. Soc. (Lond.), 95, 1353-9.
- Robinson, P. L. and Scott, W. E.
(1931) J. Chem. Soc. Lond., 693-709.
(1933) Z. anorg. Chem., 210, 57.
- Robinson, R. F.
(1918) Bull. Oregon Agr. Col. Exp. Sta., 131, 1-15.
- Robinson, R. H.
(1929) Ind. Eng. Chem., 21, 1132-5.
- Robinson, W. O. and Waggaman, W. H.
(1909) J. Phys. Chem., 13, 673-8.
- Robl, R.
(1924) Z. angew. Chem., 37, 938.
- Robson, H. L.
(1927) J. Am. Chem. Soc., 49, 2772-82.
- Rodebush, W. H.
(1918) J. Am. Chem. Soc., 40, 1204-13.
- Redwell.
(1862) J. Chem. Soc. (Lond.), 15, 59.
- Roederer, E.
(1936) Z. anorg. Chem., 226, 145-167.
- Roelofsen.
(1894) Am. Chem. Jour., 16, 466.
- Rogier and Fiore.
(1913) Bull. sci. Pharmacologique, 20, 7, 72.
- Rohland, P.
(1897) Z. anorg. Chem., 15, 412.
(1898) Z. anorg. Chem., 18, 328.
- Rohmer, R.
(1934) Compt. rend., 199, 641.
(1939) Ann. chim. [11], 11, 611-721.
- Rollet A. P.
(1930) Compt. rend., 191, 488-90.
(1935) Compt. rend., 200, 1763.

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- Rollet, A. P. and Andres, L.**
(1930) *Compt. rend.*, 191, 375, 567.
(1931) *Bull. Soc. Chim.*, (France) [4], 49, 1065-92.
- Rollet, A. P. and Graf, W.**
(1933) *Compt. rend.*, 197, 555.
- Rollet, A. P. and Lauffenburger, R.**
(1934) *Bull. soc. chim.* (France) [5], 1, 146-52.
- Rollet, A. P. and Peng Chung-Ming.**
(1935) *Bull. soc. chim.* (France) [5], 2, 982-5.
- Rollet, A. P. and Wohlgenuth, J.**
(1934) *Compt. rend.*, 198, 1772-4.
- Roloff, M.**
(1894) *Z. physik. Chem.*, 13, 341.
(1895) *Z. physik. Chem.*, 17, 325-56.
(1895) *Z. physik. Chem.*, 18, 572-84.
- Roozeboom, H. W. B.**
(1884) *Rec. trav. chim.*, 3, 29-87.
(1889) *Rec. trav. chim.*, 8, 1-146.
- Roscoe and Dittmar.**
(1859) *Liebig's Annalen*, 112-234.
- Rose, H. J.**
(1925) *Trans. Roy. Soc. (Canada)*, [3], 19 (Sec. III), 33,.
- Rosenbaum, C. K. and Walton, J. H.**
(1930) *J. Am. Chem. Soc.*, 52, 3568-73.
- Rosenblatt.**
(1886) *Ber.*, 19, 2531.
- Rosenheim, A.**
(1916) *Z. anorg. allgem. Chem.*, 96, 143.
- Rosenheim, A. and Bertheim, A.**
(1903) *Z. anorg. Chem.*, 34, 430.
- Rosenheim, A. and Davidsohn, I.**
(1903) *Z. anorg. Chem.*, 37, 315.
- Rosenheim, A. and Grunbaum.**
(1909) *Z. anorg. Chem.*, 61, 187.
- Rosenheim, A. and Krause, L.**
(1921) *Z. anorg. allgem. Chem.*, 118, 182.
- Rosenheim, A. and Leyser, F.**
(1921) *Z. anorg. allgem. Chem.*, 119, 12-19.
- Rosenheim, A. and Pritze, M.**
(1908) *Ber.*, 41, 2708.
(1909) *Z. anorg. Chem.*, 63, 275-81.
- Rosenheim, A. and Reglin, W.**
(1921) *Z. anorg. allgem. Chem.*, 120, 103-19.
- Rosenheim, A., Stadler and Jakobsohn.**
(1906) *Ber.*, 39, 2841.
- Rosenheim, A. and Thor, S.**
(1927) *Z. anorg. Chem.*, 167, 1-20.
- Rosenheim, A. and Weinheber, M.**
(1910-11) *Z. anorg. Chem.*, 69, 263.
- Rosenheim, A. and Wolff, A.**
(1930) *Z. anorg. Chem.*, 193, 56.
- Rosenheim, A. and Zickermann, J.**
(1932) *Z. anorg. Chem.*, 208, 95-9.
- Rosenmund, K. W. and Zetzsche, F.**
(1918) *Ber.*, 51, 598.
- Roshdestwensky, A. and Lewis, W. C. McC.**
(1911) *J. Chem. Soc. (Lond.)*, 99, 2144.
(1912) *J. Chem. Soc. (Lond.)*, 101, 2098.
- Ross, Merz and Jacob.**
(1929) *Ind. Eng. Chem.*, 21, 286.
- Ross, J. D. M. and Morrison, T. J.**
(1933) *J. Chem. Soc. (Lond.)*, 1016-22.
(1936) *J. Chem. Soc. (Lond.)*, 867-72.
- Ross, J. D. M., Morrison, T. J., and Johnstone, C.**
(1937) *J. Chem. Soc. (Lond.)*, 608-14.
- Ross, W. H. and Jones, R. M.**
(1925) *J. Am. Chem. Soc.*, 47, 2165.
- Rössler.**
(1873) *J. prakt. Chem.*, [2], 7, 14.
- van Rossum, C.**
(1912) *Chem. Weekblad*, 9, 396.
- Rostkowski, A. P.**
(1927) *Zhur. fiziko. chimic (Russe)*, 59, 349.
(1929a) *Zhur. fiziko-chimic (Russe)*, 61, 89.
(1929b) *Zhur. fiziko-chimic (Russe)*, 61, 98, 595.
(1930a) *Zhur. fiziko-chimic (Russe)*, 62, 2055.
(1930b) *Zhur. fiziko-chimic (Russe)*, 62, 2067.
- Roth.**
(1897) *Z. physik. Chem.*, 24, 123.

AUTHOR INDEX

- Roth, W. A. and Becker, G.**
(1932) Z. physik. Chem. (A), 159, 39.
- Rothmund, V.**
(1898) Z. physik. Chem., 26, 459, 475.
(1900) Z. physik. Chem., 33, 406.
(1908) Z. Elektrochem., 14, 532.
(1910) Z. physik. Chem., 69, 523-46.
(1912) Nernst. Festschrift, 391-4.
(1912) Chem. Zentr., II, 1261.
- Rothmund, V. and Wilsmore, N. T. M.**
(1898) Z. physik. Chem., 26, 475.
(1902) Z. physik. Chem., 40, 623.
- Rowley, H. H.**
(1936) J. Am. Chem. Soc., 58, 1337-41.
- Rubenbauer.**
(1902) Z. anorg. Chem., 30, 334.
- Rubtzov, P. P.**
(1918) J. Russ. Phys. Chem. Soc., 50, 220-4.
- Rüdorff.**
(1862) Pogg. Ann., 116, 63.
(1869) Ber., 2, 70.
(1872) Pogg. Ann., 145, 608.
(1873) Ber., 6, 482.
(1885) Ber., 18, 1160.
- Ruer.**
(1906) Z. anorg. Chem., 49, 365.
- Ruff, Otto.**
(1909) Ber., 42, 4029.
(1929) Z. anorg. Chem., 185, 387.
- Ruff, O., Ebert and Krawczynski.**
(1933) Z. anorg. Chem., 213, 333.
- Ruff, Otto and Fischer, G.**
(1903) Ber., 36, 418-28.
- Ruff, O. and Hecht, L.**
(1911) Z. anorg. Chem., 70, 61.
- Ruff, Otto and Giesel, E.**
(1906) Ber., 39, 838.
- Ruff, Otto and Plato, W.**
(1903) Ber., 36, 2358-2365.
- Ruff, O. and Schiller, E.**
(1911) Z. anorg. Chem., 72, 341.
- Ruff, Otto and Staub, L.**
(1933) Z. anorg. Chem., 212, 400.
- Ruff, O. and Winterfeld.**
(1903) Ber., 36, 2437.
- Rupert, F. F.**
(1909) J. Am. Chem. Soc., 31, 866.
(1910) J. Am. Chem. Soc., 32, 748.
- Rutten and van Bemmelen.**
(1902) Z. anorg. Chem., 30, 386.
- S.**
(1905) Apoth. Ztg., 20, 1031.
- Saalmann, E.**
(1933) Z. Ver. deutsch. Zuckerind., 83, 1007.
- Sackur, O.**
(1911-2) Z. physik. Chem., 78, 553-68.
(1913) Z. physik. Chem., 83, 297-314.
- Sackur, O. and Fritzmann, E.**
(1909) Z. Elektrochem., 15, 842-6.
- Sackur, O. and Taegener, W.**
(1912) Z. Elektrochem., 18, 722.
- Saddington, A. W. and Krase, N. W.**
(1934) J. Am. Chem. Soc., 56, 353-61.
- Sadolin, E.**
(1927) Z. anorg. Chem., 160, 133.
- Sakabe, S.**
(1914) Mem. Coll. Sci. (Kyoto), 1, 57-61.
- Salkowski, H.**
(1885) Ber., 18, 321.
(1901) Ber., 34, 1947.
- Salkower, B.**
(1916) Am. J. Pharm., 88, 484.
- Salstrom, E. J. and Smith, G. McP.**
(1930) J. Phys. Chem., 34, 2241-9.
- Salvadori,**
(1912) Gazz. chim. ital., 42, 1, 458-94.
- Salzer.**
(1886) Liebig's Ann., 232, 114.
- Sameshima, J. and Hiramatsu, T.**
(1934) Bull. Chem. Soc. (Japan), 9, 260-2.
- Sammet, V.**
(1905) Z. physik. Chem., 53, 644-48.
- von Samson-Himmelstjerna, H. O.**
(1930) Z. anorg. Chem., 186, 337.
- Sander, W.**
(1911-12) Z. physik. Chem., 78, 513-49.
- Sanders, J. P. and Dobbins, J. T.**
(1931) J. Phys. Chem., 35, 3086-9.

AUTHOR INDEX

Sandonnini, C.

- (1911) Atti accad. Lincei, [5], 20, I, 173, 253.
- (1911) Gazz. chim. ital., 41, II, 146.
- (1911) Atti accad. Lincei, [5], 20, II, 62, 497, 572, 588, 646.
- (1911a) Atti accad. Lincei, [5], 20, I, 457, 760.
- (1912) Atti accad. Lincei, [5], 21, I, 208-13, 479.
- (1912a) Atti accad. Lincei, [5], 21, II, 197, 524, 635.
- (1912b) Atti 1st. Ven., 71, 553.
- (1913) Atti accad. Lincei, [5], 22, I, 630; II, 21.
- (1914) Atti accad. Lincei, [5], 23, I, 962.
- (1914) Gazz. chim. ital., 44, I, 296, 382.

Sandonnini, C. and Aureggi, P. C.

- (1912) Atti accad. Lincei, [5], 21, I, 493.

Sandonnini, C. and Scarpa, G.

- (1911a) Atti accad. Lincei, [5], 20, II, 62.
- (1911b) Atti accad. Lincei, [5], 20, II, 497.
- (1912) Atti accad. Lincei, [5], 21, II, 77-84.
- (1913) Atti accad. Lincei, [5], 22, II, 21, 163, 518.

Sandquist, H.

- (1911) Liebig's Ann., 379, 85.
- (1912) Liebig's Ann., 392, 76.
- Ark. Kem. Min. Geol., 4, 8-81.
- (1917) Ark. Kem. Min. Geol., 7, No. 2.

Sandved, K.

- (1927) J. Chem. Soc. (Lond.), 130, 2967-74.
- (1929) J. Chem. Soc. (Lond.), 337-44.

Sanfourche, A. and Focet, B.

- (1933) Bull. soc. chim. (France) [4], 53, 974-80.

Sanfourche, A. and Gardent, L.

- (1924) Bull. soc. chim., [4], 35, 1088-93.

Sanfourche, A. and Krapivine, A.

- (1933) Bull. soc. chim. (France) [4], 53, 970-3

Sanfourche, A. and Liebaut, Mlle. A. M.

- (1922) Bull. soc. chim., [4], 31, 966-72.

Sarker, P. and Barat, T.

- (1930) J. Indian Chem. Soc., 7, 199.

Sarver, L. A. and Brinton, H. M. P.

- (1927) J. Am. Chem. Soc., 49, 943-58.

Saslowsky, A. J. and Ettinger, J. L.

- (1935) Z. anorg. Chem., 223, 277-87.
- (1937) Zhur. Obs. Khimii, 7, 1948-58.

Saslowsky, A. J., Ettinger, J. L. and Eserowa, E. A.

- (1935) Z. anorg. Chem., 225, 305-11.
- (1937) Zhur. Obs. Khimii, 7, 2410-6.

Saunders, K. H.

- (1922) J. Chem. Soc., 121, 2667-75.

Sborgi, U.

- (1913) Atti accad. Lincei, [5], 22, I, 91, 636, 716, 798.
- (1915) Atti accad. Lincei, [5], 24, I, 1225.
- (1912) Atti accad. Lincei, [5], 21, II, 855.
- (1913) Atti accad. Lincei, [5], 22, I, 90-5.
- (1924) Gazz. chim. ital., 54, 946-64.
- (1932) Gazz. chim. ital., 62, 3-15.

Sborgi, U. and Amelotti, L.

- (1930) Gazz. chim. ital., 60, 468-74.

Sborgi, U. and Bovalini, E.

- (1924) Gazz. chim. ital., 54, 919-33.

Sborgi, U., Bovalini, E. and Cappellini, L.

- (1924) Gazz. chim. ital., 54, 298-321.

Sborgi, U., Bovalini, E. and Medici, M.

- (1924) Gazz. chim. ital., 54, 934-45.

Sborgi, U. and Cappellini, L.

- (1924) Gazz. chim. ital., 54, 298-321.

Sborgi, U. and Ferri, L.

- (1921) Mem. accad. Lincei, [5], 13, 569-91.
- (1922) Atti accad. Lincei, [5], 31, I, 324-9.

Sborgi, U. and Franco, C.

- (1921) Gazz. chim. ital., 51, II, 1-57.
- (1922) Giorn. chim. ind. applicata., 4, (June).

Sborgi, U. and Gallichi, E.

- (1924) Gazz. chim. ital., 54, 255-97.

AUTHOR INDEX

- Sborgi, U. and Mecacci, F.**
(1915) Atti accad. Lincei, [5], 24, 1, 443-8, 1225-31.
(1916) Atti accad. Lincei, [5], 25, II, 327-32, 386-9, 455-8.
- Sborgi, U. and Mezzetti.**
(1921) Atti accad. Lincei, [5], 30, II, 189-94.
- Sborgi, U. and Stefanini, L.**
(1924) Gazz. chim. ital., 54, 322-38.
- Scarpa, G.**
(1912) Atti accad. Lincei, [5], 21, II, 720.
(1915) Atti accad. Lincei, [5], 24, I, 741.955; II, 476.
- Schäfer, H.**
(1905) Z. anorg. Chem., 45, 310.
- Schaefer, W.**
(1914) Neues Jahrb. Min. Geol., I, 15-24.
(1919) Neues Jahr. Min. Geol. (Beil. Bd.), 43, 132-89.
- Schattenstein, A. J. and Monossohn, A.**
(1932) Z. anorg. Chem., 207, 204-8.
- von Scheele, C.**
(1899) Ber., 32, 415.
- Scheffer, F. E. C.**
(1911) Proc. K. Akad. Wet. (Amst.), 13, 829; 14, 195.
(1912) Z. physik. Chem., 76, 161.
(1912a) Proc. K. Akad. Wet. (Amst.), 15, 380.
- Scheffer, F. E. C. and Smittenberg, J.**
(1932) Rec. trav. chim., 51, 1008-11.
(1933) Rec. trav. chim., 52, 1-8.
- Scheffer, F. E. C. and de Wijs, H. J.**
(1925) Rec. trav. chim., 44, 654.
- Scheflan, L. and McCrosky, C. R.**
(1932) J. Am. Chem. Soc., 54, 193-202.
- Scheibler, C.**
(1883) J. pharm. chim. [5], 8, 540.
- Schenck, R. and Alberio, Agnes.**
(1919) Z. anorg. allgem. Chem., 105, 146.
- Schenck, R. and Rassbach, W.**
(1908) Ber., 41, 2917.
- Scherer, P. C.**
(1931) J. Am. Chem. Soc., 53, 3694-7.
- Scheringa, K.**
(1932) Chem. Weekblad, 29, 605.
- Schiavor, G.**
(1902) Gazz. chim. ital., 32, II, 532.
- Schick, K.**
(1903) Z. physik. Chem., 42, 163.
- Schierholz.**
(1890) Sitzber. K. Akad. Wiss. (Wien.), 101, 2b, 4.
- Schiff.**
(1859) Liebig's Ann., 109, 326.
(1860) Liebig's Ann., 113, 350.
(1861) Liebig's Ann., 118, 365.
- Schiff and Monsacchi.**
(1896) Z. physik. Chem., 21, 277.
- Schimmel, F.**
(1928) Z. anorg. Chem., 176, 285-8.
(1929) Ber., 62, 963.
- Schlamp, A.**
(1894) Z. physik. Chem., 14, 272.
- Schloesing.**
(1871) Compt. rend., 73, 1273.
(1872) Compt. rend., 74, 1552; 75, 70.
- Schlossberg, J.**
(1900) Ber., 33, 1082.
- Schmidt, J. M.**
(1926) Bull. soc. chim., [47, 39, 1686-1703.
(1929) Ann. chim. [10], 11, 351-445.
- Schnellbach, W.**
(1929) Am. J. Pharm., 101, 586.
- Schnellbach, W. and Rosin, J.**
(1929) J. Am. Pharm. Assoc., 18, 762-71, 1230.
(1931) J. Am. Pharm. Assoc., 20, 227.
- Scholder, R.**
(1927) Ber., 60, 1523.
(1930) Ber., 63, 2831.
- Scholder, R., Gadenne, E. and Niemann, H.**
(1927) Ber., 60, 1510-25.
- Scholder, R. and Hendrick, G.**
(1939) Z. anorg. Chem., 241, 76-92.
- Scholder, R. and Linström, C. F.**
(1930) Ber., 63, 2831.
- Scholder, R. and Patsch, R.**
(1935) Z. anorg. Chem., 222, 135-44.

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- Scholich, K.**
(1920) Neues Jahr. Min. Geol. (Beil Bd.), **43**, 251-94.
- Scholl, A. W., Hutchinson, A. W. and Chandlee, G. C.**
(1933) J. Am. Chem. Soc., **55**, 3081-3.
- Scholl, R. and Steinkopf.**
(1906) Ber., **39**, 4393.
- Schöne.**
(1873) Ber., **6**, 1224.
- Schönfeld.**
(1885) Liebig's Ann., **95**, 5.
- Schoorl, N.**
(1903) Rec. trav. chim., **22**, 40.
(1923) Rec. trav. chim., **42**, 790-9.
- Schoorl, N. and Regenbagen, A.**
(1919) Pharm. Weekblad., **56**, 538-45.
(1922a) Rec. trav. chim., **41**, 125-34.
- Schrager, B.**
(1927) Coll. Czechoslovak Chem. Com. I, 276.
- Schrefeld.**
(1894) Z. Ver. Zuckerind., **44**, 971.
- Schreiber, J.**
(1933) These, Strasbourg.
- Schreinemakers, F. A. H.**
(1892) Z. physik. Chem., **9**, 65-71.
(1897) Z. physik. Chem., **23**, 417-41.
(1898) Z. physik. Chem., **25**, 543-67.
(1898) Z. physik. Chem., **26**, 237-54.
(1898c) Z. physik. Chem., **27**, 95-122.
(1899) Z. physik. Chem., **29**, 577.
(1900) Proc. k. Akad. Wet. (Amst.), **2**, I.
(1900) Z. physik. Chem., **33**, 79.
(1903) Z. anorg. Chem., **37**, 207.
(1906) Z. physik. Chem., **55**, 89.
(1907) Z. physik. Chem., **59**, 641.
(1908-09) Z. physik. Chem., **65**, 555, 575.
(1908) Chem. Weekblad., **5**, 847.
(1909) Z. physik. Chem., **66**, 687-98.
(1909) Chem. Weekblad., **6**, 131, 140.
(1909-10) Z. physik. Chem., **68**, 83-103.
(1910) Arch. neer. sc. ex. nat., [2], **15**, 81, 117.
(1910) Z. physik. Chem., **69**, 557-68.
(1910a) Z. physik. Chem., **71**, 109-16.
(1910b) Chem. Weekblad., **7**, 333.
(1911) Proc. k. Akad. Wet. (Amst.), **13**, 1163.
- Schreinemakers, F. A. H. and de Baat, W. C.**
(1908) Chem. Weekbl., **5**, 465-72.
(1908-9) Z. physik. Chem., **65**, 586.
(1909) Z. physik. Chem., **67**, 551-60.
(1910) Chem. Weekblad., **7**, 259.
(1910a) Arch. neer. sc. ex. nat., [2], **15**, 415.
(1914) Proc. k. Akad. Wet. (Amst.), **17**, 533, 781.
(1915) Proc. k. Akad. Wet. (Amst.), **17**, 1111.
(1915) Verslag. k. Akad. Wet. (Amst.), **23**, 1097; May.
(1917) Chem. Weekblad., **14**, 141, 203, 244.
(1917) Chem. Weekblad., **14**, 262-7, 288.
- Schreinemakers, F. A. H. and de Baat, Miss W. C.**
(1920) Rec. trav. chim., **39**, 423-8.
- Schreinemakers, F. A. H., Berkhoff, G. and Posthumus, K.**
(1924) Rec. trav. chim., **43**, 508-11.
- Schreinemakers, F. A. H. and Cocheret, D. H.**
(1905) Chem. Weekblad., **2**, 771-778.
- Schreinemakers, F. A. H. and Cocheret, D. H., Filippo, H. and de Waal, A. J. C.**
(1901) Z. physik. Chem., **59**, 645.
- Schreinemakers, F. A. H. and Deuss, J. J. B.**
(1912) Z. physik. Chem., **79**, 554.
- Schreinemakers, F. A. H. and Van Dorp, W. A. Jr.**
(1906) Chem. Weekblad., **3**, 557-561.
(1907) Z. physik. Chem., **59**, 641-69.
- Schreinemakers, F. A. H. and Figeé, T.**
(1911) Chem. Weekblad., **8**, 683-8.
- Schreinemakers, F. A. H. and Figeé, Th.**
(1912-17) Archiv. neerlandaises sci., ex. et nat., [3A], **2**, 39-44.
- Schreinemakers, F. A. H. and Filippo, A. Jr.**
(1906) Chem. Weekblad., **3**, 157-65.
(1906) Chem. Zentralbl., **77**, I, 1321.
- Schreinemakers, F. A. H. and Hoenen, P. H. J.**
(1909) Chem. Weekblad., **6**, 51.
- Schreinemakers, F. A. H. and Van der Horn van den Bos, J. L. M.**
(1912) Z. physik. Chem., **79**, 551.
- Schreinemakers, F. A. H. and Jacobs, W.**
(1910) Chem. Weekblad., **7**, 215.

AUTHOR INDEX

- Schreinemakers, F. A. H. and Kayser, G. M. A.
(1918) Chem. Weekblad., 15, 120-1.
- Schreinemakers, F. A. H. and Massink, A.
(1910) Chem. Weekblad., 7, 214.
- Schreinemakers, F. A. H. and Meijeringh, D. J.
(1908) Chem. Weekblad., 5, 811.
- Schreinemakers, F. A. H. and Noorduyn, A. C.
(1918) Chem. Weekblad., 15, 118-20.
- Schreinemakers, F. A. H. and Van Provije, D. J.
(1913) Proc. k. Akad. Wet., 15, 1326.
- Schreinemakers, F. A. H. and Thonus, J. C.
(1912) Proc. k. Akad. Wet. (Amst.), 15, 472.
- Schreinemakers, F. A. H. and de Waal, A. J. C.
(1906) Chem. Weekblad., 3, 539-43.
- Schreiner, L. and Sieverts, A.
(1935) Z. anorg. Chem., 224, 167-72.
- Schroeder, J.
(1905) Z. anorg. Chem., 44, 6.
(1908) J. prakt. Chem., [2], 77, 267-8.
- Schroeder, W. C., Berk, A. A., and Gabriel, A.
(1936) J. Am. Chem. Soc., 58, 843-9.
(1937) J. Am. Chem. Soc., 59, 1783-95.
- Schroeder, W. C., Gabriel, A. and Partridge, E. P.
(1935) J. Am. Chem. Soc., 57, 1539-46.
- Schröder, Wilhelm.
(1929) Z. anorg. Chem., 184, 63-89.
(1929a) Z. anorg. Chem., 177, 71-85.
(1929b) Caliche, 11, 154.
(1930) Z. anorg. Chem., 185, 153-66.
(1930a) Z. anorg. Chem., 185, 267-79.
(1936) Z. anorg. Chem., 228, 129-59.
(1938) Z. anorg. Chem., 239, 39-56.
- Schröder, W., Beckmann, U. and Ansel, W.
(1939) Z. anorg. Chem., 241, 179-95.
- Schröder, W., Homspesch, H. and Mirbach, P.
(1938) Z. anorg. Chem., 239, 225-39.
- Schröder, W., Kehren, E., Frings, K. and Poelvoorde, H.
(1938) Z. anorg. Chem., 238, 209-34, 305-20.
- Schröder, W. and Kleese, W.
(1938) Z. anorg. Chem., 239, 399-417.
- Schröder, W. and Schackmann, H.
(1934) Z. anorg. Chem., 220, 389-410.
- Schröder, W. and Schwedt, H.
(1938) Z. anorg. Chem., 240, 50-66.
- Schukarew, A.
(1901) Z. physik. Chem., 38, 543.
- Schuler.
(1879) Sitzb. k. Akad. Wis. (Berlin), 79, 302.
- Schultz.
(1860) Zeit. Chem., [2], 5, 531.
(1861) Pogg. Ann., 113, 137.
- Schulze.
(1881) J. prakt. Chem., [2], 24, 168.
- Schulze, A.
(1920) Z. physik. Chem., 95, 257-79.
- Schwab and Hantke.
(1924) Z. physik. Chem., 114, 251.
- Schwarze, Robert.
(1916) Ber., 49, 2359.
- Schwarze, R. and Haacke, A.
(1921) Z. anorg. allgem. Chem., 115, 87-99.
- Schwarz, R. and Heinrich, F.
(1932) Z. anorg. Chem., 205, 43.
- Schwarz, R. and Huf, E.
(1931) Z. anorg. Chem., 203, 188-217.
- Schwarz, R. and Romero, A.
(1927) Z. anorg. Chem., 162, 149-60.
- Schweitzer,
(1890) Z. anal. Chem., 29, 414.
- Schwicker.
(1889) Ber., 22, 1731.
- Scott, A. F. and Durham, E. J.
(1930) J. Phys. Chem., 34, 531-7, 1424-38.
- Scott, A. F. and Frazier, W. R.
(1927) J. Phys. Chem., 31, 459-63.
- Scott, A. F. and Johnson, C. R.
(1930) J. Am. Chem. Soc., 52, 3586.
- Sedlitzky.
(1887) Monatsh. Chem., 8, 563.
- Sehnal, J.
(1909) Compt. rend., 148, 1394.

AUTHOR INDEX

Seidell, A.

- (1902) Am.Chem.Jour., 27, 52.
- (1907) J. Am.Chem. Soc., 29, 1088-95.
- (1908) Trans. Am. Electrochem. Soc., 13, 319-29.
- (1909) J. Am.Chem. Soc., 31, 1164.
- (1910) Bull. No. 67 Hygienic Laboratory, U.S. Public Health Service.

Seliwanow, Th.

- (1914) Z. anorg. Chem., 85, 337.

Semisine, V. I.

- (1939) Zhur. Obs. Khimii, 9, 83-5.

Semzusi, S. F.

- (1927) Ann. Inst. Platin. (Russ), 5, 364.

Sendroy, Jr., J. and Hastings, A. B.

- (1927) J. Biol. Chem., 71, 783-846.

Serowy, Dr.

- (1923) Kali, 17, 289, 305, 320, 333, 345.

Serullas.

- () Ann. chim. phys., 22, 118.

Sestini.

- (1890) Gazz. chim. ital., 20, 313.

Setschenow.

- (1892) Ann. chim. phys., [6], 25, 226.

Setterburg.

- (1882) Liebig's Annalen, 211, 104.

Seubert and Elten.

- (1892) Z. anorg. Chem., 2, 434.

Seward, R. P.

- (1932) J. Am. Chem. Soc., 54, 4598-4605.
- (1934) J. Am. Chem. Soc., 56, 2610-2.

Seward, R. P. and Hamblet, C. H.

- (1932) J. Am. Chem. Soc., 54, 554-63.

Seward, R. P. and Schumb, W. C.

- (1930) J. Am. Chem. Soc., 52, 3962-7.

Seyer, W. F. and Ball.

- (1926) Trans. Roy. Soc. (Canada) III, [3], 20, 343.

Seyer, W. F. and Cornett, W. F.

- (1937) Ind. Eng. Chem., 29, 91-2.

Seyer, W. F. and Dunbar.

- (1922) Trans. Roy. Soc. (Canada), III [3], 16, 307.

Seyer, W. F. and Gallagher.

- (1926) Trans. Roy. Soc. (Canada), III, [3], 20, 343.

Seyer, W. F. and Hodnett, L.

- (1936) J. Am. Chem. Soc., 58, 996-8.

Seyer, W. F. and King, E. G.

- (1933) J. Am. Chem. Soc., 55, 3140-9.

Seyer, W. F. and Peck, W. S.

- (1930) J. Am. Chem. Soc., 52, 19.

Seyer, W. F. and Todd, Eric.

- (1929) Trans. Roy. Soc. (Canada), III, [3], 23, 67-70.
- (1931) Ind. Eng. Chem., 23, 325-7.

Seyler, C. A.

- (1908) Analyst, 33, 454-7.

Seyler, C. A. and Lloyd, P. V.

- (1909) J. Chem. Soc. (Lond.), 95, 1347-52.

Shad, H. and Bornemann, K.

- (1916) Metall. u. Erz., 13, 251-62.

Sharwood, W. J.

- (1903) J. Am. Chem. Soc., 25, 576.

Shear, M. J. and Kramer, B.

- (1928) J. Biol. Chem., 79, 125-45.

Shear, M. J., Washburn, M. and Kramer, B.

- (1929) J. Biol. Chem., 83, 697-720.

Shearman, R. W. and Menzies, W. C.

- (1937) J. Am. Chem. Soc., 56, 185-6.

Shenstone and Cundall.

- (1883) J. Chem. Soc., (Lond.), 43, 550.

Sheppard, S. E. and Hudson, H.

- (1927) J. Am. Chem. Soc., 49, 1814-19.

Sherrill, M. S.

- (1903) Z. physik. Chem., 43, 705-40.

Sherrill, M. S. and Eaton, F. M.

- (1907) J. Am. Chem. Soc., 29, 1643.

Sherrill, M. S. and Russ, D. E.

- (1907) J. Am. Chem. Soc., 29, 1657-61.

Sherrill, M. S. and Haas, A. J. Jr.

- (1936) J. Am. Chem. Soc., 58, 952-9.

Sherrill, M. S. and Izzard, E. F.

- (1928) J. Am. Chem. Soc., 50, 1665-75.
- (1931) J. Am. Chem. Soc., 53, 1667-74.

Sherwood, T. K.

- (1925) Ind. Eng. Chem., 17, 745-7.

Shibata, F. L. E.

- (1932) J. Sci. Hiroshima Univ. (A) 1, 215.

Shibata, F. L. E., Oda, S. and Furukawa, Sh.

- (1932) J. Sci. Hiroshima Univ. (A) 2, 85.

AUTHOR INDEX

- Shiomi, T.
(1908) Mem. Coll. Sci. Eng. (Kyoto), I,
406-13.
- Shnidman, L.
(1934) J. Phys. Chem., 38, 901-6.
- Showalter, H. A.
(1933) Trans. Roy. Soc. (Canada), III,
(3), 27, 183-5.
- Showalter, H. A. and Ferguson, J. B.
(1936) Canadian J. Res. (B), 14, 120-6.
- Sidersky, D.
(1921) Bull. assoc. chim. sucr. dist.,
39, 167-77.
- Sidgwick, N. V. and Eubank, E. K.
(1922) J. Chem. Soc., 121, 1844-53.
- Sidgwick, N. V. and Gentle, J. A. H. R.,
(1922) J. Chem. Soc., 121, 1837-43.
- Sidgwick, N. V. and Lewis, N. B.
(1926) J. Chem. Soc., 129, 1287-1302.
- Sidgwick, N. V. and Sutton, L. E.
(1930) J. Chem. Soc. (Lond.), 1461-72.
- Siebeck.
(1909) Scand. Arch. f. Physiol., 21, 368.
- Siegler, Robert.
(1909) Dissertation (Technischen
Hochschule), Darmstadt.
- Sieverts, A.
(1907) Z. physik. Chem., 60, 129.
(1911) Z. physik. Chem., 77, 591, 611.
(1914) Z. physik. Chem., 88, 103.
(1931) Z. physik. Chem. (A), 155, 313.
- Sieverts, A. and Bergner, E.
(1912) Ber., 45, 2576.
- Sieverts, A. and Hagen.
(1931) Z. physik. Chem. (A), 155, 317.
(1934) Z. physik. Chem. (A), 169, 238.
- Sieverts, A. and Jurisch.
(1912) Ber., 45, 221.
- Sieverts, A. and Müller, E. L.
(1931) Z. anorg. Chem., 200, 305-20.
- Sieverts, A. and Müller, H.
(1930) Z. anorg. Chem., 189, 241-57.
(1930) Caliche, 12, 91.
- Sieverts, A. and Petzold, W.
(1932) Z. anorg. Chem., 205, 113-26.
(1933) Z. anorg. Chem., 212, 49-60, 233-41.
(1933a) Z. anorg. Chem., 214, 27-32,
- Sieverts, A. and Schreiner, L.
(1934) Z. anorg. Chem., 219, 105-12.
- Sieverts, A. and Zapf, G.
(1935) Z. physik. Chem. (A), 174, 359.
- Sieverts, A., Zapf, G. and Moritz, H.
(1938) Z. physik. Chem. (A), 183, 19-37.
- Sill, H. F.
(1905) Z. physik. Chem., 51, 577-602.
(1916) J. Am. Chem. Soc., 38, 2632.
- Sims.
(1861) Liebig's Ann., 118, 340.
- Simmons, J. P., Freimuth, H. and Russell, H.
(1936) J. Am. Chem. Soc., 58, 1692-5.
- Simmons, J. P. and Ropp, C. D. L.
(1928) J. Am. Chem. Soc., 50, 1650-3.
- Simmons, J. P. and Waldeck, W. F.
(1931) J. Am. Chem. Soc., 53, 1725-7.
- Simons, J. H.
(1931) J. Am. Chem. Soc., 53, 83-7.
- Sirucek, J.
(1938) J. chim. phys., 35, 136-42.
- Siskin, N. V. and Pochvaleusky, E. D.
(1938) Zhur. Obs. Khimii, 8, 1125-31.
- Sisokin, V. P.
(1927) Ann. Inst. Polytechn. (Leningrad),
30, 385.
- Sisskind, Bertha and Kasarnowski, I.
(1931) Z. anorg. Chem., 200, 279-86.
(1933) Z. anorg. Chem., 214, 385-95.
- Skalik.
(1928) Schr. d. Königsberger Gel.
Ges. Naturw. Klasse, 5, 102.
- Skirrow, F. W.
(1902) Z. physik. Chem., 41, 144.
- Skinner, S.
(1892) J. Chem. Soc. (Lond.), 61, 342.
- Skossareswky, M. and Tchitchinadze, N.
(1916) J. Chim. phys., 14, 153-75.
- Slade, R. E.
(1912) Z. Elektrochem., 18, 1.
- Sloan and Mallet.
(1882) Chem. News., 46, 194.
- Smirnof, Vladimir.
(1907) Z. physik. Chem., 58, 373, 667.
- Smith.
(1912) Landolt and Börnstein
Tabellen, 5th Ed., 481.

AUTHOR INDEX

- Smith and Bradbury.
(1891) Ber., 24, 2930.
- Smith, A. and Carson, C. M.
(1908) Z. physik. Chem., 61, 200.
- Smith, A. and Eastlack, H. E.
(1916) J. Am. Chem. Soc., 38, 1500, 1265.
- Smith, A., Holmes, W. B. and Hall, E. S.
(1905) J. Am. Chem. Soc., 27, 805.
- Smith, A. and Menzies, A. W. C.
(1909) J. Am. Chem. Soc., 31, 1183-91.
- Smith, C. M.
(1920) J. Am. Chem. Soc., 42, 259-65.
- Smith, D. F.
(1923) J. Am. Chem. Soc., 45, 365.
- Smith, F. Hastings.
(1917) J. Am. Chem. Soc., 39, 1309.
- Smith, G. F.
(1923a) J. Am. Chem. Soc., 45, 2074.
(1924) J. Am. Chem. Soc., 46, 1581.
(1925) J. Am. Chem. Soc., 47, 762-9.
- Smith, G. F. and Ring, F.
(1937) J. Am. Chem. Soc., 59, 1889-90.
- Smith, G. McP. and Ball, T. R.
(1917) J. Am. Chem. Soc., 39, 217.
- Smith, H. A. and Taylor, H.
(1938) J. Am. Chem. Soc., 60, 1696-7.
- Smith, Herbert, J.
(1918) J. Am. Chem. Soc., 40, 879-85.
- Smith, L.
(1928) Z. anorg. Chem., 176, 155.
- Smith, S. B.
(1931) J. Am. Chem. Soc., 53, 3711-18.
- Smith, S. B. and Ely, E. C.
(1938) J. Am. Chem. Soc., 60, 2909-11.
- Smith, S. B. and Sturm, W. A.
(1933) J. Am. Chem. Soc., 55, 2414-9.
- Smith, S. B., Sturm, W. A. and Ely, E. C.
(1935) J. Am. Chem. Soc., 57, 2406-8.
- Smith, W. R.
(1909) J. Am. Chem. Soc., 31, 245.
- Smith, W. T. and Parkhurst, R. B.
(1922) J. Am. Chem. Soc., 44, 1918-27.
- Smits, A. and Bokhorst, S. C.
(1915) Z. physik. Chem., 89, 374.
- Smits, A., Elgersma, J. and Hardenberg, M. E.
(1924) Rec. trav. Chim., 43, 671.
- Smits, A. and Kettner, A.
(1912) Proc. k. Akad. Wet. (Amst.), 15, 685.
- Smits, A. and de Leeuw, H. L.
(1910) Proc. k. Akad. Wet. (Amst.), 13, 329.
- Smits, A. and Maarse, J.
(1911) Proc. k. Akad. Wet. (Amst.), 14, 192.
- Smits, A. and Mazee, W. M.
(1928) Z. physik. Chem., 135, 73.
- Smits, A. and de Mooy.
(1910) Verslag. Akad. Wet. (Amst.), 19, 293.
- Smits, A. and Postma, S.
(1914) Proc. k. Akad. Wet. (Amst.), 17, 183.
- Smits, A., Rinse, J. and Louwe-Kooymans, L. H.
(1928) Z. physik. Chem., 135, 73-84.
- Smolensky, S.
(1911-12) Z. anorg. Chem., 73, 293.
- Smyth, L.
(1928) Z. anorg. Chem., 176, 171.
- Smyth and Adams.
(1923) J. Am. Chem. Soc., 45, 1167.
- Sneider.
(1866) Pogg. Ann., 127, 624.
- Snell, J. F.
(1898) J. Phys. Chem., 2, 474, 484.
- Snyder.
(1878) Ber., 11, 936.
- Soch, C. A.
(1898) J. Phys. Chem., 2, 43.
- Sokalov, V. A.
(1939) Zhur. Obs. Khimii, 9, 753-8.
- Sörensen, S. P. L.
(1925) J. Am. Chem. Soc., 47, 457.
- Sosman, R. B. and Merwin, H. E.
(1916) J. Wash. Acad. Sci., 6, 532-37.
- Souchay and Leussen.
(1856) Liebig's Ann., 99, 33.
- Sowerby, A. L. McRae.
(1927) J. Chem. Soc. (Lond.), 130, 1337-42.
- Spack, A.
(1930) These, Strasbourg.

AUTHOR INDEX

- Spencer, J. F.**
(1912) Z. physik. Chem., 80, 701.
(1913) Z. physik. Chem., 83, 293.
- Spencer and LePla.**
(1909) Z. anorg. Chem., 65, 14.
- Speyers, C. L.**
(1902) Am. J. Sci., [4], 14, 294.
- Spicin, W. J.**
(1917) J. Chem. Soc. Russ., 49, 357-70.
- Spielrein, C.**
(1913) Compt. rend., 157, 46.
- Spinoglis, P. and Ravenna.**
(1935) Gazz. chim. ital., 65, 668-78.
- Spitzen, V. I.**
(1917) J. Russ. Phys. Chem. Soc., 49, 357-70.
- Spring and Romanoff.**
(1896) Z. anorg. Chem., 13, 34.
- Squire, P. W. and Caines, C. M.**
(1905) Pharm. Jour. (Lond.), 74, 720, 784.
- v. Stackelberg, E. F.**
(1896) Z. physik. Chem., 20, 337-58.
- v. Stackelberg, M.**
(1934) Z. physik. Chem., (A), 170, 262-72.
- v. Stackelberg, M., Quantram, F. and Dresoll, J.**
(1937) Z. Elektrochem., 43, 21.
- Stalhave, B.**
(1930) Z. Elektrochem., 36, 404-8.
- Stanbridge, F.**
(1918) J. Chem. Soc., 113, 808-16.
- Stanley, H.**
(1904) Chem. News, 89, 193.
- Stark, G.**
(1911) Z. anorg. Chem., 70, 174.
- Starkowa, S. P.**
(1931) Zhur. Obs. Khimii, 1, 747-9.
- Starokadomskaja, E. L.**
(1939) Zhur. Obs. Khimii, 9, 840-4.
- Staronka, W.**
(1910) Anzeiger akad. Wis. Krakau. Ser. A., 372-98.
(1910) Chem. Zentralbl., 81, 1741.
- Starrs, B. A. and Clark, L.**
(1930) J. Phys. Chem., 34, 1058-63.
- Stasevich, N.**
(1913) J. Russ. Phys. Chem. Soc., 45, 912-30.
- Staub, F. G.**
(1932) Ind. Eng. Chem., 24, 914-7.
- Steacie, E. W. R. and Johnson, F. M. G.**
(1928) Proc. Roy. Soc. (Lond.), 117, 662-79.
- Steele and Johnson.**
(1904) J. Chem. Soc. (Lond.), 85, 116.
- Steger.**
(1903) Z. physik. Chem., 43, 595.
- Steiner, P.**
(1894) Ann. der. Physik. (Wiederman), 52, 275.
- Steinwehr.**
(1902) Ann. der Physik. (Drude), [4], 9, 1050.
- v. Steinwehr, H.**
(1920) Z. physik. Chem., 94, 17.
- Stern, Otto.**
(1912-13) Z. physik. Chem., 81, 468.
- Stewart, J.**
(1922) Soil Science, 14, 111-8.
- Stiassny.**
(1891) Monatsh. Chem., 12, 601.
- Stich, C.**
(1903) Pharm. Ztg., 48, 343.
(1903) Pharm. Jour. (Lond.), 70, 700.
- Stock, A.**
(1904) Ber., 37, 1432.
(1910) Ber., 43, 156, 1227.
- Stock, A. and Kuss, E.**
(1917) Ber., 50, 159-64.
- Stock, A. and Others.**
(1934) Z. anorg. Chem., 217, 241-53.
- Stoddard, J. L.**
(1927) J. Biol. Chem., 71, 629-92.
- Stolba.**
(1865) J. prakt. Chem., 94, 406.
(1867) J. prakt. Chem., 101, 1.
(1872) Z. anal. Chem., 11, 199.
(1877) Chem. Centralbl., 418, 578.
(1883) Chem. Centralbl., 293.
(1889) Chem. Techn. Cent., Anz., 7, 459.

AUTHOR INDEX

- Stolle.**
(1900) Z.Ver.Zuckerind., 50, 331.
- Stollenwerk, W.**
(1926) Z.anorg.allgem.Chem., 156, 37-55.
- Stollenwerk, W.**
(1926) Z.anorg.Chem., 156, 37-55.
- Stoltzenberg, H.**
(1912) Ber., 45, 2248.
(1914) Z.physik.Chem., 92, 461-94.
- Stortenbecker, W.**
(1888) Rec.trav.chim., 7, 152.
(1889) Z.physik.Chem., 3, 11.
(1897) Z.physik.Chem., 22, 62.
(1900) Z.physik.Chem., 34, 109.
(1902) Rec.trav.chim., 21, 407.
(1907) Rec.trav.chim., 26, 245.
- Story, L.G. and Anderson, E.**
(1924) J.Am.Chem.Soc., 46, 533.
- Straub, Jan.**
(1911) Z.physik.Chem., 77, 332.
- Strauli, L.**
(1918) These, Zurich.
(1926) "Tabelles Annuelles", 5, 932.
- Strock, L.W. and McCutcheon, T. P.**
(1931) J.Am.Chem.Soc., 53, 2852.
- Strömholm, D.**
(1900) Ber., 33, 835.
(1903) Z.physik.Chem., 44, 721-32.
(1908) Z.anorg.Chem., 57, 72-103.
- Struve.**
(1854) J.prakt.Chem., 61, 460.
(1870) Z.anal.Chem., 9, 34.
(1899) J.prakt.Chem., [2], 61, 457.
- Stuckgold, M.**
(1917) J.chim.phys., 15, 502-16.
- Stumper.**
(1925) Bull.soc.chim.(Belg.), 34, 422-7.
- Sudhaus, Käthe.**
(1914) Neues Jahrb.Min.Geol.(Beil. Be.), 37, 1-50.
- Sugden, Ruth.**
(1926) J.Chem.Soc., 129, 960-1.
(1929) J.Chem.Soc.(Lond.), 488-91.
- Sulc.**
(1900) Z.anorg.Chem., 25, 401.
- Sullivan.**
(1905) J.Chem.Soc., 27, 529.
- Sunier, A. A. and Gramke, B. E.**
(1929) J.Am.Chem.Soc., 51, 1703-8.
- Sunier, A. A. and Hess, C. B.**
(1928) J.Am.Chem.Soc., 50, 662-8.
- Sunier, A. A. and Weiner, L. G.**
(1931) J.Am.Chem.Soc., 53, 1714-21.
- Sunier, A. A. and White, C. M.**
(1930) J.Am.Chem.Soc., 52, 1842-50.
- Süss, J.**
(1913) Z.Kryst.Min., 51, 262.
- Svecova, K. B.**
(1938) Zhur.Obs.Khimii, 8, 690-4.
- Swan, Clifford, M.**
(1899) "Chemistry Thesis," Mass. Inst.Technology, (unpublished).
(1911) J.Am.Chem.Soc., 33, 1814.
- Swearingen, L. E. and Florence, R. T.**
(1935) J.Phys.Chem., 39, 701-7.
- de Sweeney, A.**
(1932) Naturwetensch,Tijdscher, 14, 231.
- Swenson, T. and Ricci, J. E.**
(1939) J.Am.Chem.Soc., 61, 1974-7.
- Swinne, R.**
(1913) Z.physik.Chem., 84, 348.
- Sworykin, A. J.**
(1927) Z.anorg.Chem., 163, 178-84.
- Taber, W. C.**
(1906) J.Phys.Chem., 10, 593.
(1906) Bull., 33, Bureau of Soils, U.S.Dept.Agr.
- Tacchini, G.**
(1924) Gazz.chim.ital., 54, 777.
- Takahashi, G.**
(1927) Bull.Imp.Hyg.Lab.(Tokyo), 29, 165.
- Takahashi, Y.**
(1919) Mem.Coll.Sci.Kyoto, Imp. Univ., 4, 47-50.
- Takayama, Y.**
(1930) J.Soc.Chem.Ind.(Japan), 33, 302.

AUTHOR INDEX

- Takegami, S.**
 (1920) J. Tokyo Chem. Soc., 41, 831-68.
 (1921) Mem. Coll. Sci. Kyoto, Imp. Univ., 4, 317-42.
 (1921a) J. Chem. Soc. Tokyo, 42, 441-53.
 (1922) Mem. Coll. Sci. Kyoto, Imp. Univ., 5, 191-9.
- Takenchi, J.**
 (1915) Mem. Coll. Sci. (Kyoto), 1, 249-55.
- Tamm, O.**
 (1910) Z. physik. Chem., 74, 499.
- Tammann, G.**
 (1930) Z. anorg. Chem., 188, 396.
- Tammann, G., Kollman, K. and Hinnüber.**
 (1927) Z. anorg. Chem., 160, 242-9.
- Tammann, G. and Krings, W.**
 (1923) Z. anorg. allgem. Chem., 130, 242.
- Tammann, G. and Olsen.**
 (1930) Z. anorg. Chem., 193, 245.
- Tammann, G. and Schaftmeister, P.**
 (1924) Z. anorg. allgem. Chem., 138, 219-32.
- Tanaka, H.**
 (1930) J. Soc. Chem. Ind. (Japan) Suppl. 33, 488B.
- Tananaev, Iv.**
 (1938) Zhur. Obs. Khimii., 8, 1120-4.
- Tananaev, Iv. and Tchrelachwili, S.**
 (1936) Zhur. Obs. Khimii., 6, 606-11.
- Tantzov, N. V.**
 (1924) J. Russ. Phys. Chem. Soc., 55, 335-41.
 (1925) Chem. Abs., 19, 2437.
- Tarassenkow, D. N. and Katz, K.**
 (1937) Zhur. Obs. Khimii., 7, 2243-5.
- Tarassenkow, D. N. and Poloshinzewa, E. N.**
 (1931) Zhur. Obs. Khimii., 1, 71-9.
 (1932) Ber., 65, 184-6.
- Tarbutton, G., Egan, E. P. Jr. and Frary, S. G.**
 (1939) J. Am. Chem. Soc., 61, 2555-6.
- Tarbutton, G. and Vosburgh, W. C.**
 (1932) J. Am. Chem. Soc., 54, 4537-44.
- Tartar, H. V. and Lorah, J. R.**
 (1929) J. Am. Chem. Soc., 51, 1091.
- Tartar, H. V., Rice, M. R. and Sweo, B. J.**
 (1931) J. Am. Chem. Soc., 53, 3949-56.
- Tartar, H. V., Wood, L. and Hines, E.**
 (1924) J. Am. Chem. Soc., 46, 812.
- Tartar, H. V. and Wright, K. A.**
 (1939) J. Am. Chem. Soc., 61, 539-44.
- Tarugi, N.**
 (1904) Gazz. chim. ital., 34, 1, 329.
 (1914) Gazz. chim. ital., 44, 1, 131.
- Tarugi, N. and Checchi, Q.**
 (1901) Gazz. chim. ital., 31, 11, 439, 445.
- Taverne, H. J.**
 (1900) Rec. trav. chim., 19, 109.
- Taylor, H. S., Caley, E. R. and Eyring, H.**
 (1933) J. Am. Chem. Soc., 55, 4334.
- Taylor, H. S. and Henderson, W. N.**
 (1915) J. Am. Chem. Soc., 37, 1692.
- Taylor, N. W. and Hildebrand, J. H.**
 (1923) J. Am. Chem. Soc., 45, 682-94.
- Taylor, S. F.**
 (1897) J. Phys. Chem., 1, 301, 468, 720.
- Teepie, John. E.**
 (1929) "The Industrial Development of Searles Lake Brines"
 The Chem. Catalogue Co., New York, N. Y.
- Tereda, K.**
 (1928) Bull. Inst. Phys. Chem. Res. (Tokyo), 7, 455.
- Terres, E. and Behrens, H.**
 (1928) Z. physik. Chem., 130, 695-716.
- Terres, E. and Brückner, K.**
 (1920) Z. Elektrochem., 26, 1-32.
- Terres, E. and Constantinescu, M.**
 (1934) Z. angew. Chem., 47, 470.
- Terres, E. and Rühl, G.**
 (1934) Z. angew. Chem., 47, 331-4.
- Terres, E. and Welser, H.**
 (1921) Z. Elektrochem., 27, 177-93.
- Terrey, H. and Jolly, V. G.**
 (1923) J. Chem. Soc., 123, 2217-22.
- Terrey, H. and Spong, H.**
 (1932) J. Chem. Soc. (Lond.), 219-26.
- Tettamanzi, A.**
 (1933) Gazz. chim. ital., 63, 575-9.
- Thiel, A.**
 (1900) Z. anorg. Chem., 27, 57.

AUTHOR INDEX

- Thiel, A. and Koelsch.
(1910) Z. anorg. Chem., **66**, 309.
- Thiel, A. and Schulte, E.
(1920) Z. physik. Chem., **96**, 312-42.
- Thilo.
(1892) Chem. Ztg., **16**, II, 1688.
- Thin, R. G. and Cumming, Alex. C.
(1915) J. Chem. Soc. (Lond.), **107**, 361-6.
- Thomas.
(1896) Compt. rend., **123**, 943.
- Thomas, J. S. and Rule, A.
(1917) J. Chem. Soc. (Lond.), **111**, 1063-85.
- Thompson, H. E. Jr.
(1935) J. Phys. Chem., **39**, 655-64.
- Thompson, M. de K.
(1910) Met. Chem. Eng., **8**, 279, 324.
(1910) Proc. Am. Acad., **45**, 431-52.
- Thorvaldson, Th., Grace, N. G. and Vigfusson, V. A.
(1929) Canadian, J. Res., **1**, 201.
- Tichomirow, W.
(1907) J. Russ. Phys. Chem. Soc., **39**, 731-43.
(1908) Chem. Zentralbl., **1**, 11.
- Tilden, W. A.
(1884) J. Chem. Soc. (Lond.), **45**, 269, 409.
- Tilden and Shenstone.
(1883) Proc. Roy. Soc. (Lond.), **35**, 345.
(1884) Phil. Trans., 23-31.
(1885) Proc. Roy. Soc. (Lond.), **38**, 331.
- Timofelew, Wladimir.
(1890) Z. physik. Chem., **6**, 147.
(1891) Compt. rend., **112**, 1137, 1224.
(1894) Dissertation (Kharkhov.)
- Timmermans, J.
(1907) Z. physik. Chem., **58**, 129-213.
(1910) Proc. k. Akad. Wet. (Amst.), **13**, 523.
(1911) "Recherches expérimentales sur les phénomènes de demixtion des mélanges liquides" (Thèse) Bruxelles. April, 1911.
(1912) Bull. soc. chim. (Belg.), **26**, 382.
- Timmermans, J. and Dumont, M.
(1931) Bull. soc. chim. (Belg.), **40**, 689-709.
- Ting, H. H. and McCabe, W. L.
(1934) Ind. Eng. Chem., **26**, 1207-8.
- Tiollais, Rene.
(1936) Bull. soc. chim. (France), **51**, 3, 70-87.
- Tiollais, R. and Perdreau, H.
(1939) Bull. soc. chim. (France) **51**, 6, 631-46.
- Tobler.
(1855) Liebig's Ann., **95**, 193.
- Toda, S.
(1921) Mem. Coll. Sci. Kyoto, Imp. Univ., **4**, 305-10.
(1921a) Mem. Coll. Sci. Kyoto, Imp. Univ., **4**, 377-82.
(1922) J. Chem. Soc. Japan, **43**, 320-40.
- Tolmatschew, P. J.
(1930) Compt. Rend. Akad. Sci., U. S. S. R. Russ. Doklady Akad. Nank. Ser. A, **689**.
- Tollert, H.
(1932) Z. anorg. Chem., **204**, 142.
- Tomicek, O. and Kubik, J.
(1937) Coll. Czechoslovak. Chem. Com., **9**, 525-41.
- Tomula, E. S.
(1921) Z. anorg. Chem., **118**, 88.
- Toole, F. J. and Johnson, F. M. G.
(1933) J. Phys. Chem., **37**, 331-46.
- Toporescu, E.
(1922) Compt. rend., **174**, 870.
- Touren.
(1900) Compt. rend., **130**, 259, 908, 1252.
- Tourneux, C.
(1919) Ann. chim., **97**, 11, 225-61.
(1934) Bull. soc. chim. (France) **51**, 1, 1043-9.
- Tourneux, C. and Pernot, M.
(1925) Compt. rend., **180**, 740.
- Tower.
(1906) Z. anorg. Chem., **50**, 382.
- Townley, R. W., Whitney, W. B. and Felsing, W. A.
(1937) J. Am. Chem. Soc., **59**, 631-3.

AUTHOR INDEX

- Trapp, Hans.**
(1935) J. prakt. Chem., 143, 193-210.
- Traube, I.**
(1909) Ber., 42, 2185, 4185-8.
- Trautz and Anschütz.**
(1906) Z. physik. Chem., 56, 238.
- Trautz, Max and Dalai, V. P.**
(1920) Z. anorg. allgem. Chem., 110, 1-47.
- Trautz, M. and Gerwig, W.**
(1925) Z. anorg. allgem. Chem., 145, 4-15.
- Travers, A. and Malaprade.**
(1926) Bull. soc. chim., [4], 39, 1543-73.
- Travers, A. and Nouvel.**
(1929) Compt. rend., 188, 499.
- Travers, A. and Sehnoutka, J.**
(1930) Ann. chim. [10], 13, 253-331.
- Treadwell and Reuter.**
(1898) Z. anorg. Chem., 17, 185.
- Treis, K.**
(1914) Neues. Jahr. Min. (Beil. Bd.), 37, 766-818.
- Trenner, N. R. and Taylor, H. A.**
(1931) J. Phys. Chem., 35, 1336-44.
- Trevor.**
(1891) Z. physik. Chem., 7, 470.
- rifonov, N.**
(1924) Mitt. wiss. 6th Arheuten Republik (Russia), 13, 72.
(1925) Chem. Zentr., II, 382.
- Trimble, H. M.**
(1922) J. Am. Chem., 44, 451-60.
(1931) Ind. Eng. Chem., 23, 165.
(1936) J. Am. Chem. Soc., 58, 1868.
- Trömel.**
(1932) Mitt. Kais. Wilh. Inst. f. Eisenf. 14, 25.
- Trömel and Korber.**
(1932) Z. Elektrochem., 38, 578.
- Trüthe, W.**
(1912) Z. anorg. Chem., 76, 129-73.
- Ts'ai Liu-Sheng and Yen Wen-Hsing.**
(1936) J. Chinese Chem. Soc., 4, 178-82.
- Tsakalotos, D. E.**
(1913) Bull. soc. chim. (France) [4], 13, 282.
- Tschugajew, L. A.**
(1926) Ann. Inst. Platinum (Russ.), 4, 1.
- Tschugajew, L. A. and Fritmann, E. I.**
(1928) Z. anorg. Chem., 172, 225.
- Tschugaef, L. A. and Chlopin, W. (Chugaev, L. and Khlopin, W.)**
(1914) Z. anorg. Chem., 86, 159.
- Tschugaef, L. A. and Kiltinovic, S. S.**
(1916) J. Chem. Soc. (Lond.), 109, 1286.
- Tuchschmidt, C. and Follenius, O.**
(1871) Ber., 4, 583.
- Tubaudt, C. and Eggert, S.**
(1920) Z. anorg. allgem. Chem., 110, 220-3.
- Tubaudt, C. and Münzing, E.**
(1927) Z. anorg. Chem., 160, 323.
- Tunell, G. and Posnjak, E.**
(1931) J. Phys. Chem., 35, 929-46.
- Turner, W. E. S. and Bissett, C. C.**
(1913) J. Chem. Soc. (Lond.), 103, 1904.
- Turner, W. E. S. and English.**
(1914) J. Chem. Soc. (Lond.), 105, 1786.
- Tutton, A. E. H.**
(1897) J. Chem. Soc. (Lond.), 71, 850.
(1907) Proc. Roy. Soc. (Lond.), 79, (A) 351-82.
- Tyrer, Dan.**
(1910) Jour. Chem. Soc. (Lond.), 97, 1778-88.
(1910a) Jour. Chem. Soc. (Lond.), 97, 621-32.
(1911) Proc. Chem. Soc. (Lond.), 27, 142.
- Tyson, F. T.**
(1939) J. Am. Chem. Soc., 61, 183-5.
- Ueda, V.**
(1933) Sci. Reports Tohoku Univ., (1) 22, 472.
- Uspenskii.**
(1929) Neftyanoe Khozyaistvo, 17, 713.
- U. S. P., VIII.**
(1907) U. S. Pharmacopoeia, 8th decennial revision.
- Usher, F. L.**
(1908) Z. physik. Chem., 62, 622-5.
(1910) J. Chem. Soc. (Lond.), 97, 66-78.

AUTHOR INDEX

Ussó.

(1904) Z.anorg.Chem., **38**, 419.

Ullmann, F. and Kertesz, P.

(1919) Ber., **52B**, 545-58.

Uyeda, K.

(1909-10) Mem. Coll. Sci. Eng. (Kyoto),
2, 245-61.

(1912-13) Mem. Coll. Sci. Eng. (Kyoto),
5, 147-50.

(1912) 8th Int. Cong. Appl. Chem., **22**,
237.

Valenta.

(1894) Monatsh. Chem., **15**, 250.

Valentin, J.

(1922) Compt. rend., **175**, 1061.

Valentiner, S.

(1922) Ber. physik. Ges., **3**, 62-3.

(1927) Z. Physik., **25** (?), 269.

Valeton, J. J. P.

(1910) Verslag k. Akad. Wet. (Amst.),
18, 755.

Valeton, J. J. and Fromel, W.

((1924) Z. anorg. allgem. Chem., **137**,
91-100.

Valeur, A.

(1917) Compt. rend., **164**, 818-20.

Vallance, R. H.

(1922) Chem. News, **125**, 7.

(1927) J. Chem. Soc. (Lond.), **130**, 1328-34.

(1931) J. Chem. Soc. (Lond.), 1421-7.

Van Arkel, A. E. and Lebbink, F. J.

(1937) Rec. trav. chim., **56**, 208-10.

Van Eyk, C.

(1899) Z. physik. Chem., **30**, 430.

(1900) Proc. k. Akad. Wet. (Amst.), **2**, 480.

(1901) Proc. k. Akad. Wet. (Amst.), **3**, 98.

(1905) Z. physik. Chem., **51**, 721.

(1905) Chem. News., **91**, 295.

Van Dorp, G. C. A.

(1923) Rec. trav. chim., **42**, 765-74.

Van't Hoff see van't Hoff.

Van Klooster, H. S. and Owens, R. M.

(1935) J. Am. Chem. Soc., **57**, 670-1.

Van Liempt, J. A. M.

(1922) Z. anorg. allgem. Chem., **122**, 175-80.

(1925) Z. anorg. allgem. Chem., **143**, 285-92.

Van Meurs, G. J.

(1916) Z. physik. Chem., **91**, 313-46.

Van Name, R. S. and Brown, W. G.

(1917) Am. Jour. Sci., [4], **44**, 105-23.

Van Rysselberge.

() These, Bruxelles.

Van Slyke, D. D., Dillon, R. T. and Margaria, R.

(1934) J. Biol. Chem., **105**, 571.

Van Slyke, D. D. and Neill, J. M.

(1924) J. Biol. Chem., **61**, 523.

Van Slyke, D. D. and Sendroy, J. Jr.

(1928) J. Biol. Chem., **78**, 801.

Van Slyke, D. D., Sendroy, J. Jr.,

Hastings, A. B. and Neill, J. M.

(1928) J. Biol. Chem., **78**, 765-99.

Vanstone, E.

(1914) J. Chem. Soc. (Lond.), **105**,
1491-1503.

(1925) J. Chem. Soc. (Lond.), **127**, 550-2.

Van Veldhuizen, H.

(1929) These, Utrecht.

Van Wyk, H. J.

(1902) Z. anorg. Chem., **32**, 115.

(1905) Z. anorg. Chem., **47**, 1-52.

Varenne and Pauleau.

(1881) Compt. rend., **93**, 1016.

Vasiliev, A. M. (Wasilieff).

(1909) J. Russ. Phys. Chem. Soc., **41**,
748-53; 953-7.

(1910) J. Russ. Phys. Chem. Soc., **42**,
423, 562-81.

(1910) Chem. Zentralbl., **II**, 1527.

(1910) "Tables annuelles," **1**, 381.

(1911) J. Russ. Phys. Chem. Soc.

(1912) Chem. Abs., **6**, 577.

(1912) J. Russ. Phys. Chem. Soc., **44**, 1076.

Venable, C. S. and Greene, C. D.

(1922) Ind. Eng. Chem., **14**, 319.

Vesterberg, A.

(1912) 8th Inter. Congr. Appl. Chem., **2**,
238, 255.

Vesterberg, K. A.

(1916) Z. anorg. allgem. Chem., **94**, 371.

(1917) Ark. kemi Min. Geol., **6**, No. 11.

Vilbrandt, F. C. and Bender, J. A.

(1923) Ind. Eng. Chem., **15**, 967-9.

AUTHOR INDEX

- Virck.**
(1862) Chem. Centralbl., 402.
- Voerman, G. L.**
(1905) Chem. Weekblad, 2, 766.
(1906) Chem. Weekblad, 3, 784, 806.
(1906) Chem. Zentralbl., 77, 1, 125.
(1907) Rec. trav. chim., 26, 293.
- Von Euler, see von Euler.**
- Vogel, Fritz.**
(1903) Z. anorg. Chem., 35, 389.
- Vogel.**
(1867) Neues Repert. Pharm., 16, 557.
(1874) Neues Repert. Pharm., 23, 335.
- Vold, R. D. and Ferguson, R. H.**
(1938) J. Am. Chem. Soc., 60, 2066-76.
- Voogd, N. H. J. M.**
(1933) Rec. trav. chim., 52, 768.
- Vortisch, E.**
(1914) Neues Jahrb. Min. Geol. (Beil., Bd.), 38, 185-272.
(1914a) Neues Jahrb. Min. Geol. (Beil., Bd.), 38, 513-24.
- Vosburg, W. C., Israel, K. and Birch, O. G.**
(1936) J. Am. Chem. Soc., 58, 2282-3.
- Vosburg, W. C. and Lackey, O. N.**
(1930) J. Am. Chem. Soc., 52, 1407-10.
- Vosburg, W. C., Newlin, I. G., Puette, L. A., Peck, R. L. and Dick, R.**
(1936) J. Am. Chem. Soc., 58, 2079.
- Vosnesenskij, J. A.**
(1927) Zhur. Obs. Khimii, 59, 225.
- de Waal, A. J. C.**
(1910) Dissertation, Leyden.
(1910) "Tables annuelles."
- Waddell, John.**
(1898) J. Phys. Chem., 2, 236.
(1899) J. Phys. Chem., 3, 160.
(1900) J. Phys. Chem., 4, 161.
- Waddell, J.**
(1918) Analyst, 43, 287-9.
- Wadsworth, A. E. and Dawson, H. M.**
(1926) J. Chem. Soc., 129, 2784-6.
- Waentig, P. and McIntosh, D.**
(1915) Trans. Roy. Soc. (Canada), [3], 9, (Sec. III), 203-9.
- Wagner, C. L.**
(1910) Z. physik. Chem., 71, 430.
- Wagner, K. L. and Zerner, E.**
(1911) Monatsh. Chem., 31, 833.
- Wagemmann, K.**
(1912) Metallurgie, 9, 518, 537.
- Waldeck, W. F., Lynn, G. and Hill, A. E.**
(1932) J. Am. Chem. Soc., 54, 928-36.
(1934) J. Am. Chem. Soc., 56, 43-7.
- Walden, P. T.**
(1905) Am. Chem. Jour., 34, 149.
(1906) Z. physik. Chem., 55, 712.
- Walden, P. T. and Centnerszwer, M.**
(1902-03) Z. physik. Chem., 42, 432-68.
- Waldman, A. and Klatchko-Gourvitch, L.**
(1935) Zhur. Obs. Khimii, 5, 791-4.
- Walker, A. C., Bray, U. B. and Johnston, J.**
(1927) J. Am. Chem. Soc., 49, 1235-56.
- Walker, J. and Fyffe, W. A.**
(1903) J. Chem. Soc. (Lond.), 83, 179.
- Walker, O. J.**
(1925) J. Chem. Soc., 127, 61-6.
- Wallace.**
(1855) J. Chem. Soc. (Lond.), 7, 80.
- Wallace.**
(1909) Z. anorg. Chem., 63, 1.
- Walter, G., Adler, M. and Reimer, G.**
(1934) Monatshefte Chem., 65, 59-81.
- Walter, Z. T. and Schlundt, H.**
(1928) J. Am. Chem. Soc., 50, 3266.
- Walton, J. H. Jr., and Judd, R. C.**
(1911) J. Am. Chem. Soc., 33, 1036.
- Walton, J. H., and Lewis, H. A.**
(1916) J. Am. Chem. Soc., 38, 633.
- Walton, J. H. and Whitford, E. L.**
(1923) J. Am. Chem. Soc., 45, 601-6.
(1930) J. Am. Chem. Soc., 52, 2189.
- Walton, J. H. and Wise, C. R.**
(1922) J. Am. Chem. Soc., 44, 103-4.
- Warington.**
(1875) J. Chem. Soc., 28, 946.
- Waris, Ghulam.**
(1925) Quart. J. Indian Chem. Soc., 1, 307-10.
- v. Wartenberg.**
(1924) Ann. (Liebig's), 440, 97-110.

AUTHOR INDEX

- V. Wartenberg and Gurr.**
(1931) Z. anorg. Chem., 196, 374.
- V. Wartenberg, and Podjaski.**
(1925) Z. anorg. Chem., 148, 391.
- V. Wartenberg and Prophet.**
(1932) Z. anorg. Chem., 208, 369.
- v. Wartenberg, and Werth.**
(1930) Z. anorg. Chem., 190, 178.
- Warynski, T. and Kourapatwinska, S.**
(1916) J. chim. phys., 14, 328-35.
- Wasilieff see Vasiliev .**
- Wassilieff, A. A. and Martinoff, N. N.**
(1935) Z. anal. Chem., 103, 103-6.
- Wassilieff, B. B., Ettinger, J. L. and Golowkov, M. M.**
(1934) Z. anorg. Chem., 219, 341-7.
- Watt, G. W. and Fernelius, W. C.**
(1935) Z. anorg. Chem., 221, 187.
- Waxberg.**
(1930) Zhur. Obs. Khimii, 62, 1265.
- Webb, K. R. and Prideaux, E. B. P.**
(1938) J. Chem. Soc. (Lond.), 111-6.
- Weber, L. J.**
(1929) Z. anorg. Chem., 181, 385-93.
- Wedekind, E. and Paschke, F.**
(1910) Z. physik. Chem., 73, 127.
- Wegschneider, R. and Mehl, J.**
(1928) Monatshefte Chem., 49, 283-315.
- Wegschelder, R. and Walter, H.**
(1905) Monatsh. Chem., 26, 685.
(1907) Monatsh. Chem., 28, 633-72.
- Weigel, O.**
(1906) Nachr. kgl. Ges. Göttingen, p. 525-48.
(1907) Z. physik. Chem., 58, 293-300.
- Weiller, P.**
(1911) Z. physik. Chem., 35, 1063-5.
- von Weimarn, P. P.**
(1911) Z. physik. Chem., 76, 218.
- Weinhardt, A.**
(1926) Dissertation, T. H. Stüttgart.
- Weinland, R. F. and Heinzler, J.**
(1920) Ber., 53B, 1362.
- Weisberg.**
(1896) Bull. soc. chim., [3], 15, 1097.
(1899) Bull. soc. chim. (France) [3], 21, 775.
(1900) Bull. soc. chim. (France) [3], 23, 740.
- Weisz and Opalski see Zerner**
- Weitz, Ernst.**
(1914) Ann., 410, 119.
- Weitz, Ernst and Stamm, H.**
(1925) Z. Elektrochem., 31, 546.
- Wellman, H. B.**
(1930) J. Am. Chem. Soc., 52, 985-999.
- Wells, H. L.**
(1892) Am. Jour. Sci., [3], 44, 221.
- Wells, H. L. and Wheeler, H. L.**
(1892) Am. Jour. Sci., [3], 43, 475.
- Wells, R. C.**
(1915) J. Wash. Acad. Sci., 5, 617-22.
(1915) J. Am. Chem. Soc., 37, 1704.
(1918) Pub. Carnegie Inst., 213, 316.
- Wells, R. C. and McAdam, D. J., Jr.**
(1907) J. Am. Chem. Soc., 29, 721-7.
- Welsh, T. W. B. and Broderson, H. J.**
(1915) J. Am. Chem. Soc., 37, 816.
- Welton, R. C. and King, G. B.**
(1939) J. Am. Chem. Soc., 61, 1251-2.
- Wempe, G.**
(1912) Z. anorg. Chem., 78, 298-327.
- Wenger.**
(1892) Am. Chem. Jour., 16, 466.
- Wenger, Paul.**
(1911) Dissertation, Genève.
(1911) "Tables annuelles," 2, 411.
- Wentzel.**
() Dammer's "Handbuch," II, 2, 858.
- Wenze.**
(1891) Z. angew. Chem., 5, 691.
- Wester, D. H. and Bruins, A.**
(1914) Pharm. Weekblad, 51, 1443-6.
- Weston, Arnold.**
(1922) J. Chem. Soc., 121, 1223-37.
- Wheat, J. A. II and Browne, A. W.**
(1936) J. Am. Chem. Soc., 58, 2410-13.
(1938) J. Am. Chem. Soc., 60, 371.

AUTHOR INDEX

- Wheeler, H. L.**
 (1892) *Am. J. Sci.*, [3], 44, 123.
 (1893) *Am. J. Sci.*, [3], 45, 267.
 (1893a) *Z. anorg. Chem.*, 3, 432.
- Whipple, G. C. and Whipple, M. C.**
 (1911) *J. Am. Chem. Soc.*, 33, 362.
- Whitby, G. S.**
 (1910) *Z. anorg. Chem.*, 67, 107-9.
- Whitby, L.**
 (1932) *Trans. Faraday Soc.*, 28, 474-8.
 (1933) *Trans. Faraday Soc.*, 29, 415-25
 523-31, 853-61, 1327.
- White, A. McLaren.**
 (1933) *J. Am. Chem. Soc.*, 55, 3182.
- White, H. A.**
 (1919) *J. Chem. Met. Min. Soc.*, S. Africa,
 20, 1-8, 15, 97-101.
 (1923) *J. Chem. Met. Min. Soc.*, S.
 Africa, 23, 170, 218.
- Whitman, W. G., Russell, R. B. and Davis,
 G. H. B.**
 (1925) *J. Am. Chem. Soc.*, 47, 70-9.
- Whitney, W. R. and Melcher, A. C.**
 (1903) *J. Am. Chem. Soc.*, 25, 78.
- Whittaker, C. W., Lindstrom, F. O. and
 Shimp, J. H.**
 (1936) *J. Am. Chem. Soc.*, 58, 1975-7.
- Wibaut, J. P.**
 (1909) *Chemisch weekblad*, 6, 401.
 (1913) *Rec. trav. chim.*, 32, 269.
- Widmark, E. M. P.**
 (1923) *Biochem.*, J. 17, 668.
- Wiebe, R. and Gaddy, V. L.**
 (1934) *J. Am. Chem. Soc.*, 56, 76-9.
 (1935) *J. Am. Chem. Soc.*, 57, 847-51, 1487.
 (1937) *J. Am. Chem. Soc.*, 59, 1984.
 (1939) *J. Am. Chem. Soc.*, 61, 315-8.
- Wiebe, R., Gaddy, V. L. and Heins, C. Jr.**
 (1932) *Ind. Eng. Chem.*, 24, 823-5, 927.
 (1933) *J. Am. Chem. Soc.*, 55, 947-53.
- Wiebe, R. and Tremearne, T. H.**
 (1933) *J. Am. Chem. Soc.*, 55, 975-8.
 (1934) *J. Am. Chem. Soc.*, 56, 2357.
- Wieth.**
 (1929) *Physik. Z.*, 30, 126.
- Wigand, A.**
 (1910) *Z. physik. Chem.*, 75, 235.
- Wilcox, K. W. and Bailey, C. R.**
 (1927) *J. Chem. Soc. (Lond.)*, 130, 150-3.
- Wilke, E. and Martin, W.**
 (1927) *Z. physik. Chem.*, 125, 420-30.
- Wilke-Dörfurt, E. and Gunzert, Th.**
 (1933) *Z. anorg. Chem.*, 215, 369-87.
- Wilke-Dörfurt, E. and Mureck, H. G.**
 (1929) *Z. anorg. Chem.*, 184, 121-34.
- Wilke-Dörfurt, E. and Niederer, K.**
 (1929) *Z. anorg. Chem.*, 184, 145-66.
- Wilke-Dörfurt, E. and Schliephake, O.**
 (1928) *Z. anorg. Chem.*, 170, 129-44.
 (1929) *Z. anorg. Chem.*, 183, 301-10.
- Wilkie, H. F.**
 (1921) *Chem. Met. Eng.*, 25, 1186.
- Wilkerson, L., Bathhurst, N. O., and
 Parton, H. N.**
 (1937) *Trans. Faraday Soc.*, 33, 623-8.
- Wilkinson, I. A., Neilson, C. and
 Wylde, H. M.**
 (1920) *J. Am. Chem. Soc.*, 42, 1377.
- Willard, H. H. and Kassner, J. L.**
 (1930) *J. Am. Chem. Soc.*, 52, 2391-96.
 (1930a) *J. Am. Chem. Soc.*, 52, 2402-8.
- Willard, H. H. and Smith, G. F.**
 (1922) *J. Am. Chem. Soc.*, 44, 2816.
 (1923a) *Chem. News*, 127, 42, 57.
 (1923) *J. Am. Chem. Soc.*, 45, 286-97.
- Williams, M. D., Fogg, H. G. and James, C.**
 (1925) *J. Am. Chem. Soc.*, 47, 297-301.
- Williams.**
 (1921) *Chem. News*, 122, 62.
- Willstaetter.**
 (1904) *Ber.*, 37, 3753.
- Wilmore.**
 (1900) *Z. physik. Chem.*, 35, 305.
- Wing, H. J.**
 (1927) *J. Am. Chem. Soc.*, 49, 2859-61.
- Wing, H. J. and Thompson, T. J.**
 (1926) *J. Am. Chem. Soc.*, 48, 104-6.

AUTHOR INDEX

- Winkler, L.W.**
 (1887) J.prakt.Chem., [2], 34, 177;
 36, 177.
 (1891) Ber., 24, 3609.
 (1899) Chem.Ztg., 23, 687.
 (1901) Ber., 34, 1409, 1421.
 (1905) Landolt and Börnstein "Tab-
 ellen," 3rd Ed., p.604.
 (1906) Z.physik.Chem., 55, 350.
 (1912) Landolt and Börnstein "Tab-
 ellen," 4th Ed., p.597, 601.
- Winteler, F.**
 (1900) Z.Elektrochem., 7, 360.
- Winther, C.**
 (1923-24) Trans.Faraday Soc., 19, 280.
- Wirth, F.**
 (1908) Z.anorg.Chem., 58, 219.
 (1912) Z.anorg.Chem., 76, 174-200.
 (1912-13) Z.anorg.Chem., 79, 357.
 (1914) Z.anorg.Chem., 87, 1-12.
- Wirth, F. and Bakke, B.**
 (1914) Z.anorg.Chem., 87, 29, 47.
- Wise, C. R.**
 (1923) J. Am. Chem. Soc., 45, 1233.
- Wise, W. C. A. and Davies, C. W.**
 (1938) J. Chem. Soc. (Lond.), 273-7.
- Witt, O. N.**
 (1915) Ber., 48, 767.
- v. Wittorff, N.**
 (1904) Z.anorg.Chem., 41, 83.
- Wöhler, L. and Schäffer, W.**
 (1925) Z.anorg.allgem.Chem., 149, 391.
- Wohlgemuth, J.**
 (1934) Compt.rend., 199, 601.
- Wohlk, A.**
 (1934) Dansk.Tidskr.Farm., 8, 107.
- Wolf, G.**
 (1935) Compt.rend., 200, 1203-5.
- Wolff.**
 (1905) Z.anorg.Chem., 45, 102.
- Wolkov, P. A.**
 (1926) Ann.Inst.phys.chem.Anal.
 (Leningrad), 3, 704.
 (1927) Ann.Inst.phys.chem.anal.
 (Leningrad), 3; (2) 714-5.
- Wolkowitsch, S. I., Berlin, L. E. and
 Manzev, B. M.**
 (1932) Russ.Chimi.Shurm(Ser.B)
 Shurm prikladnoi Chimi., 5, 1.
- Wolkowitsch, S. I. Belopolski, A. P. and
 Lebeden, B. A.**
 (1931) Russ.chim.shurm. (Ser.B)
 Shurm prikladnor.Chimi, 4, 177.
- Wolters.**
 (1910) N.Jahrb.Min.Geol. (Beil.Bd.),
 30, 57.
- Wood, J. Kerfoot.**
 (1908) J. Chem. Soc. (Lond.), 93, 412.
- Wood, J. K. and Scott, J. D.**
 (1910) J. Chem. Soc. (Lond.), 97, 1573.
- Wood, T. B. and Jones, H. O.**
 (1907-08) Proc.Cambridge Phil.Soc.,
 14, 171-6.
- Woodman, R. M.**
 (1933) J. Soc. Chem. Ind., 52, 185-8.
- Worden, E. C.**
 (1907) J. Soc. Chem. Ind., 26, 452.
- Worley, F. P.**
 (1905) J. Chem. Soc. (Lond.), 87, 1107.
- Worthington, K. K. and Haring, M. M.**
 (1931) Ind. Eng. Chem. (Anal. Ed.), 3, 7.
- Woskrassens, H. K.**
 (1934) Zhur.Obs.Khimii, 4, 153-67.
- Woskresenskaja.**
 (1929) Zhur.Obs.Khimii, 61, 79.
- Wosnessensky, S. and Astachow, K.**
 (1925) Z.physik.Chem., 118, 295.
 (1927) Z.physik.Chem., 128, 363.
- Woudstra, H. W.**
 (1912) 8th Int.Cong.Appl.Chem., 12, 251.
- Wurmser, Mle.**
 (1922) Compt.rend., 174, 1466.
- Wright and Thomson.**
 (1884-85) Phil.Mag. [57], 17, 288; 19, 1.
- Wright, Rob't.**
 (1927) J. Chem. Soc. (Lond.), 130, 1334-7.
- Wright, R. H. and Maass, O.**
 (1932) Canadian J. Res., 6, 94-101.
- Wroblewski,**
 (1882) Compt.rend., 94, 1335.

AUTHOR INDEX

- Wroczyński, A. and Guye, P. A.**
(1910) *J. chim. phys.*, **8**, 197.
- Wrzesnewsky, J. B.**
(1912) *Z. anorg. Chem.*, **74**, 95.
- Wuite, J. P.**
(1913-14) *Z. physik. Chem.*, **86**, 349-82.
- Wuth, B.**
(1902) *Ber.*, **35**, 2415.
- van Wyk, see Van Wyk.**
- Wynne-Jones, W.**
(1930) *J. Chem. Soc. (Lond.)*, 1064.
- Wyrouboff, G.**
(1869) *Ann. chim. phys.*, **147**, 16, 292.
(1901) *Bull. soc. chim.*, **137**, 25, 105, 121.
- Yagoda, H.**
(1930) *J. Am. Chem. Soc.*, **52**, 3068-76.
- Yamamoto, T.**
(1908) *J. Coll. Sci. (Tokyo)*, **25**, XI.
(1930) *Sci. Papers Inst. Phys. Chem. Res. (Tokyo)*, **13**, 190-206.
(1930) *Bull. Inst. Phys. Chem. Res. (Tokyo)*, **9**, 352.
- Yost, D. M. and Stone, W. E.**
(1933) *J. Am. Chem. Soc.*, **55**, 1890.
- Young, S. W.**
(1897) *J. Am. Chem. Soc.*, **19**, 851.
- Young, S. W. and Burke, W. E.**
(1904) *J. Am. Chem. Soc.*, **26**, 1417.
(1906) *J. Am. Chem. Soc.*, **28**, 321.
- Yutzy, H. C. and Kolthoff, I. M.**
(1937) *J. Am. Chem. Soc.*, **59**, 916.
- Zahorsky.**
(1893) *Z. anorg. Chem.*, **3**, 41.
- Zambonini, F.**
(1913) *Atti accad. Lincei*, **[5]**, **22**, I, 523.
(1920) *Gazz. chim. ital.*, **50**, II, 128-46.
- Zambonini, F. and Cagliotti, V.**
(1924) *Atti accad. Lincei*, **[5]**, **33**, 308, 385.
(1925) *Atti accad. Lincei*, **[6]**, **2**, 153-8.
(1927) *Atti accad. Lincei*, **[6]**, **5**, 630-6.
- Zambonini, F. and Carobbi, G.**
(1924) *Atti accad. Lincei*, **[5]**, **33**, II, 301-8.
(1925a) *Atti accad. Lincei*, **[6]**, **2**, 300-05, 374-7.
(1925) *Atti accad. Lincei*, **[6]**, **1**, 278-83.
- Zambonini, F. and Restaino, S.**
(1926) *Atti accad. Lincei*, **[6]**, **3**, 178-83.
(1926a) *Atti accad. Lincei*, **[6]**, **4**, 5-10, 175-81.
(1927) *Atti accad. Lincei*, **[6]**, **5**, 828-32.
(1929) *Atti accad. Lincei*, **[6]**, **9**, 131-3.
(1929) *Atti accad. Lincei*, **[6]**, **10**, 774-9.
(1931) *Atti accad. Lincei*, **[6]**, **13**, 650-4.
(1931) *Atti accad. Lincei*, **[6]**, **14**, 69-71.
- Zambonini, F. and Stolfi, A.**
(1926) *Atti accad. Lincei*, **[6]**, **4**, 424-9.
(1927) *Atti accad. Lincei*, **[6]**, **5**, 832-7.
- Zapata, C. and Zapata.**
(1930) *Anales. Soc. Esp. físic. quim.*, **28**, 603-10.
- Zappi, E. V. and Manini, A.**
(1929) *Anales Assoc. quim. Argentina*, **17**, 90.
- Zawidski, V.**
(1904) *Z. physik. Chem.*, **47**, 721.
- Zeisberg, F. C.**
(1925) *Chem. Met. Eng.*, **32**, 326.
- Zeitlin, S. M.**
(1926) *Z. physik. Chem.*, **121**, 39-44.
- Zemcznzy, S. F.**
(1908) *Z. anorg. Chem.*, **57**, 267.
(1926) *Z. anorg. Chem.*, **153**, 47-61.
- Zemcznzy and Rambach.**
(1910) *Z. anorg. Chem.*, **65**, 403.
- Zerner, E., Weisz, H. and Opalski, H.**
(1922) *Z. angew. Chem.*, **35**, 253-6.
- Zieler, H.**
(1927) *Z. anorg. Chem.*, **162**, 190.
- Zink, Julius.**
(1933) *Z. anal. Chem.*, **91**, 246-58.
- Zink, J. and Liere, R.**
(1915) *Z. angew. Chem.*, **28**, 226-32.
- Zocher, H.**
(1920) *Z. anorg. allgem. Chem.*, **112**, 1-66.
- Zouravlev, D. I.**
(1939) *Zhur. Obs. Khimii*, **9**, 769-70.
- Zuccari, G.**
(1914) *Boll. Chim. Form.*, **53**, 321.
(1915) *Anna[li] Chim. Applicata.*, **3**, 277.

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AlCl ₃ +AlBr ₃	83	Ba(OH) ₂ +Ba(ClO ₃) ₂ +H ₂ O.....	163
AlNa ₃ F ₆ +H ₂ O.....	1260	" +BaCl ₂ +H ₂ O.....	156
Al ₂ O ₃ +MgO+CaO.....	309	" +Ba(NO ₃) ₂ +H ₂ O.....	176
Ag+S.....	1455	" +Ba(CH ₃ COO) ₂ +H ₂ O.....	136
AgBr+AlBr ₃	83	" +Ba(SCN) ₂ +H ₂ O.....	148
" +KBr+H ₂ O.....	686	Ba(SCN) ₂ +AgSCN+H ₂ O.....	29
" +LiBr.....	900	BaSO ₄ +K ₂ CO ₃ +H ₂ O.....	731
" +PbBr ₂	1369	BeCl ₂ +AgCl.....	48
AgCN+KCl.....	718	" +BaCl ₂	162
AgCl+CaCl ₂	290	BeNa ₂ F ₄ +H ₂ O.....	1260
" +CuCl.....	488	BiBr ₃ +AlBr ₃	83
" +NH ₄ Cl.....	1093	" +AsBr ₃	105
" +PbCl ₂	1394	BiS+Sb ₂ S ₃	1483
" +RbCl.....	1434	Bi ₂ Te ₃ +Bi ₂ S ₃	205
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AgI+KI.....	823	" +AsBr ₃	105
AgNO ₂ +NaNO ₂ +H ₂ O.....	1274	" +Bi.....	199
AgNO ₃ +Ca(NO ₃) ₂ +H ₂ O.....	302	" +SbBr ₃	1473
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" +Cu(OH) ₂ +H ₂ O.....	495	CBr ₄ +AlBr ₃	83
" +HgBr ₂	611	" +Br.....	214
" +HgI ₂	648	CCl ₃ NO ₂ +N ₂ O ₄	1145
" +NH ₄ NO ₃	1115	CCl ₄ +Br.....	213
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" +PbS.....	1408	" +I.....	678
" +Sb ₂ S ₃	1483	" +N ₂ O ₂	1145
Ag ₂ SO ₄ +Al ₂ (SO ₄) ₃ +H ₂ O.....	97	" +TiCl ₄	1548
" +CaSO ₄ +H ₂ O.....	330	" +SO ₂	1465
" +Li ₂ SO ₄	933	CHBr ₃ +N ₂ O.....	1145
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As+S.....	1455	" +Cl.....	399
AsBr ₃ +AlBr ₃	83	" +N ₂ O ₂	1145
" +SbBr ₃	1473	" +HCl.....	578
AsI ₃ +SbI ₃	1483	CHI ₃ +I.....	678
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B ₂ O ₃ +(NH ₄) ₂ O+H ₂ O.....	1046	" +NH ₄ CH ₃ COO+H ₂ O.....	1056
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" +As ₂ O ₃ +H ₂ O.....	109	" +NaCH ₃ COO.....	1168
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BaCl ₂ +As ₂ O ₃ +H ₂ O.....	109	CH ₃ CONH ₂ +CaCl ₂	293
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" +NaCl+H ₂ O.....	1223	" +NaBr+H ₂ O.....	1160
Ba(ClO ₃) ₂ +BaCl ₂ +H ₂ O.....	155	CH ₃ OH+Br.....	214
Ba(NO ₂) ₂ +AgNO ₂ +H ₂ O.....	69	" +CCl ₄ +H ₂ O.....	215
Ba(NO ₃) ₂ +AgNO ₃ +H ₂ O.....	62	" +CO ₂	237
" +NH ₄ NO ₃ +H ₂ O.....	1111	" +CS ₂	239, 240

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$\text{CH}_3\text{OH}+\text{Cl}_2$	399	$\text{CO}_2+\text{NH}_3+\text{H}_2\text{O}$	1066-9
" +HCl.....	578	$\text{CS}_2+\text{H}_2\text{S}$	598
" +SO ₂	1465	" +NH ₃	1042
" +H ₂ S.....	598	$\text{CaBr}_2+\text{AlBr}_3$	83
$(\text{CH}_2)_2(\text{COOH})_2+\text{Na}_2(\text{CH}_2)_2(\text{COO})_2+\text{H}_2\text{O}$	1172	" +As ₂ O ₃	109
$(\text{CH}_2)_2\text{CO}+\text{Br}_2$	214	$\text{Ca}(\text{C}_6\text{H}_{10}\text{O}_7)_2+\text{As}_2\text{O}_3+\text{H}_2\text{O}$	108
" +Cl.....	399	" +B ₂ O ₃ +H ₂ O.....	119
" +HCl.....	576	$\text{CaCl}_2+\text{As}_2\text{O}_3+\text{H}_2\text{O}$	109
" +CO ₂	237	" +BaCl ₂	162
" +HCl.....	578	" +BaO.....	179
" +H ₂ S.....	598	" +BaSO ₄	186
$\text{C}_2\text{H}_5\text{OH}+\text{Br}_2$	214	" +BeCl ₂	190
" +CCl ₄	217	" +CaBr ₂	244
" + " +H ₂ O.....	214-5	" +CaCO ₃	276
" +CS ₂	239-40	" +Ca(OH) ₂ +H ₂ O.....	311
" + " +H ₂ O.....	239	" +CdCl ₂	364
" +Cl.....	399	$\text{Ca}(\text{ClO}_3)_2+\text{CaCl}_2+\text{H}_2\text{O}$	282
$(\text{C}_2\text{H}_5)_2\text{O}+\text{Br}_2$	214	$\text{CaF}_2+\text{AlF}_3$	90
" +Cl.....	399	" +CaBr ₂	244
" +HCl.....	576	" +CaCl ₂	290
$\text{C}_3\text{H}_7\text{COOH}+\text{NaC}_3\text{H}_7\text{COO}$	1170	$\text{CaI}_2+\text{CaCl}_2$	290
$\text{C}_4\text{H}_6\text{O}_4+\text{H}_2\text{BO}_3+\text{H}_2\text{O}$	128	" +CaF ₂	297
$\text{C}_6\text{H}_5\text{CH}_3(\text{NO}_2)_3+\text{N}_2\text{O}_2$	1145	" +CaO+H ₂ O.....	311
$\text{C}_6\text{H}_5\text{CH}_3\text{NO}_2+\text{N}_2\text{O}_2$	1145	" +I.....	678
$\text{C}_6\text{H}_4(\text{CH}_3)_2+\text{NaC}_{18}\text{H}_{33}\text{O}_2+\text{H}_2\text{O}$	1188	$\text{Ca}(\text{NO}_3)_2+\text{Ba}(\text{NO}_3)_2$	175
$\text{C}_6\text{H}_4(\text{COOH})_2+\text{MgC}_6\text{H}_4(\text{COO})_2+\text{H}_2\text{O}$	944	" +CaCl ₂ +H ₂ O.....	283
$\text{C}_6\text{H}_5\text{Br}+\text{N}_2\text{O}_2$	1145	" +CaO+H ₂ O.....	312
$\text{C}_6\text{H}_5\text{OH}+\text{Ba}(\text{OH})_2+\text{H}_2\text{O}$	178	$\text{CaO}+\text{CaCO}_3$	276
$\text{C}_6\text{H}_4(\text{OH})_2+\text{Ba}(\text{OH})_2+\text{H}_2\text{O}$	179	" +CaCl ₂	290
$\text{C}_6\text{H}_5\text{OH}+\text{Ca}(\text{OH})_2+\text{H}_2\text{O}$	315	" + " +H ₂ O.....	282, 284
" +H ₂ SO ₄	600	$\text{Ca}(\text{OH})_2+\text{CaBr}_2+\text{H}_2\text{O}$	243
" +LiOH+H ₂ O.....	930	$\text{CaS}+\text{CaSiO}_3$	347
" +NaC ₁₈ H ₃₃ O ₂ +H ₂ O.....	1188	$\text{CaSO}_4+\text{CaCl}_2$	290
" +NaOH+H ₂ O.....	1173	$\text{CaS}_2\text{O}_3+\text{Ca}(\text{NO}_3)_2+\text{H}_2\text{O}$	304
$\text{C}_6\text{H}_{12}\text{O}_6+\text{NaCl}+\text{H}_2\text{O}$	1247	$\text{CaSiO}_3+\text{CaCO}_3$	276
$\text{C}_6\text{H}_{14}\text{O}_6+\text{H}_2\text{BO}_3+\text{H}_2\text{O}$	128	" +CaCl ₂	290
$\text{C}_8\text{H}_6\text{O}_4+\text{Li}_2\text{C}_8\text{H}_4\text{O}_4+\text{H}_2\text{O}$	905	" +CaF.....	297
" +Na ₂ C ₆ H ₄ O ₄ +H ₂ O.....	1179	$\text{CaTiO}_3+\text{CaSiO}_3$	347
$\text{C}_8\text{H}_8\text{O}_3+\text{LiC}_8\text{H}_7\text{O}_3+\text{H}_2\text{O}$	906	$\text{CdC}_2\text{O}_4+(\text{NH}_4)_2\text{C}_2\text{O}_4+\text{H}_2\text{O}$	1076
" +NaC ₈ H ₇ O ₃ +H ₂ O.....	1178-9	$\text{CdCl}_2+\text{AgNO}_3$	69
" +RbC ₈ H ₇ O ₃ +H ₂ O.....	1431-2	" +BaCl ₂	162
" +TlC ₈ H ₇ O ₃ +H ₂ O.....	1540	" + " +H ₂ O.....	157
$\text{C}_8\text{H}_{10}\text{N}_4\text{O}_2+\text{H}_2\text{O}+\text{KI}$	816	" +BeCl ₂	190
$\text{C}_8\text{H}_{10}\text{N}_4\text{O}_2\cdot\text{H}_2\text{O}+\text{NaC}_6\text{H}_5\text{COO}+\text{H}_2\text{O}$	1177	" +CaCl ₂	290
" +NaC ₆ H ₄ OHCOCOOH ₂ O.....	1177	" +CdBr ₂	352
$\text{C}_{10}\text{H}_{16}\text{O}+\text{N}_2\text{O}_4$	1145	" +NH ₄ Cl.....	1093
$\text{C}_{12}\text{H}_{22}\text{O}_{11}+\text{BaO}+\text{H}_2\text{O}$	179	$\text{CdC}_2\text{S}_4(\text{SO}_4)_2+\text{H}_2\text{O}$	465
$\text{C}_{12}\text{H}_{22}\text{O}_{11}+\text{NaCl}+\text{H}_2\text{O}$	1247	$\text{CdF}_2+\text{CdBr}_2$	352
$\text{CO}(\text{NH}_2)_2+\text{CaBr}_2+\text{H}_2\text{O}$	243	" +CdCl ₂	364
" +CaCl ₂ +H ₂ O.....	292	$\text{CdI}_2+\text{AgNO}_3$	69
" +Ca(NO ₃) ₂	308	" +CdBr ₂	352
" +KNO ₃ +H ₂ O.....	850	" +CdCl ₂	364
" +MgSO ₄ +H ₂ O.....	994	" +CdF ₂	366
" +NE ₃ +CO ₂	237	$\text{Cd}(\text{NH}_4)\text{Br}_2\cdot\frac{1}{2}\text{H}_2\text{O}+\text{H}_2\text{O}$	1051
" +NH ₄ NO ₃	1114	$\text{Cd}(\text{NO}_3)_2+\text{Ca}(\text{NO}_3)_2$	309
" + " +H ₂ O.....	1114	$\text{CdRb}_2(\text{SO}_4)_2+\text{H}_2\text{O}$	1440
" +NaNO ₃	1282	$\text{CdSO}_4+\text{CdCl}_2$	364

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C1 + AsCl ₃	106	CuS ₂ + Ag ₂ S.....	73
" + Br.....	213	CuS + Sb ₂ S ₃	1483
" + Bi.....	199	CuSO ₄ + Al ₂ (SO ₄) ₃ + H ₂ O.....	98
" + CCl ₄	216	" + BeSO ₄ + H ₂ O.....	194
Co ₃ Bi ₂ (NO ₃) ₁₂ + H ₂ O.....	203	" + CoSO ₄ + H ₂ O.....	432
Co ₃ [Ce(NO ₃) ₆] ₂ + H ₂ O.....	389	" + Cu(NO ₃) ₂ + H ₂ O.....	492
CoCl ₂ + BaCl ₂ + H ₂ O.....	157	CuTl ₂ (SO ₄) ₂ + H ₂ O.....	1558
" + CaCl ₂	290	FeCl ₃ + AlCl ₃ + H ₂ O.....	84
" + " + H ₂ O.....	285	" + CaCl ₂	290
" + CdCl ₂ + H ₂ O.....	356, 359	" + CuCl + H ₂ O.....	476
CoCs ₂ (SO ₄) ₂ + H ₂ O.....	465	" + CuCl.....	488
Co ₃ [Gd(NO ₃) ₆] ₂ + HNO ₃	549	" + CoCl ₂	417
CoK ₃ (C ₂ O ₄) ₃ + H ₂ O.....	744	" + " + H ₂ O.....	407
CoK ₂ (NO ₂) ₆ + C ₂ H ₅ OH + H ₂ O.....	833	" + NH ₄ Cl.....	1093
" + H ₂ O.....	878	FeCs ₂ (SO ₄) ₂ + H ₂ O.....	465
Co ₃ [La(NO ₃) ₆] ₂ + HNO ₃ + H ₂ O.....	894	FeFe ₃ + NaF.....	1260
Co ₃ [Nd(NO ₃) ₆] ₂ + H ₂ O.....	1332	Fe(NH ₄) ₂ (C ₂ O ₄) ₂ + CH ₃ OH.....	1078
CoPb(NH ₄)(CN) ₆ + H ₂ O.....	1063	Fe(NO ₃) ₃ + Al(NO ₃) ₃ + H ₂ O.....	91
Co ₃ [Pr(NO ₃) ₆] ₂ + H ₂ O.....	1421	Fe ₂ O ₃ + CaO.....	309
" + HNO ₃	1421	FeRh ₂ (SO ₄) ₂ + H ₂ O.....	1440
CoRb ₂ (SO ₄) ₂ + H ₂ O.....	1440	FeSO ₄ + Al ₂ (SO ₄) ₃ + H ₂ O.....	98
CoSO ₄ + CuSO ₄ + H ₂ O.....	506, 510	" + CuSO ₄ + H ₂ O.....	499, 500
CoTl ₃ (CN) ₆ + H ₂ O.....	1542	FeSO ₄ · K ₂ SO ₄ + H ₂ O.....	863
Cr ₂ Cs ₂ (SO ₄) ₄ + H ₂ O.....	465	FeSO ₄ · (NH ₄) ₂ SO ₄ + CuSO ₄ (NH ₄) ₂ SO ₄ + H ₂ O.....	510
CrK ₃ (CN) ₆ + H ₂ O.....	718	FeTl ₄ (CN) ₆ + H ₂ O.....	1542
CrTl(SO ₄) ₂ + H ₂ O.....	1559	FeTl(SO ₄) ₂ + H ₂ O.....	1559
CsAl ₂ (SO ₄) ₄ + H ₂ O.....	105	GaCs(SO ₄) ₂ + H ₂ O.....	464
CsAuCl ₄ + H ₂ O.....	116	GaCs(SeO ₄) ₂ + H ₂ O.....	464
CsBr + Br ₂ + H ₂ O.....	207	GeAg ₂ F ₆ + H ₂ O.....	56
CsCl + AgCl.....	48	GeCl ₄ + SO ₂	1465
" + AgI.....	6	GeK ₂ F ₆ + H ₂ O.....	809
" + CoCl ₂ + H ₂ O.....	40	H ₂ BO ₃ + H ₂ O.....	1046
" + FeCl ₃ + H ₂ O.....	524	" + Ca(OH) ₂ + H ₂ O.....	242
2CsClUO ₂ Cl ₂ + H ₂ O.....	1563	HBr + Br.....	213
Cs[Co(NH ₃) ₂ (NO ₂) ₄] + H ₂ O.....	422, 427	H ₂ C ₂ O ₄ + K ₂ C ₂ O ₄ + H ₂ O.....	741-3
CsF + AlF ₃	90	" + Li ₂ C ₂ O ₄ + H ₂ O.....	911
CsNO ₃ + AgNO ₃	69	" + (NH ₄) ₂ C ₂ O ₄ + H ₂ O.....	1076
CsNO ₃ · UO ₂ (NO ₃) ₂ + H ₂ O.....	1567	" + Na ₂ C ₂ O ₄ + H ₂ O.....	1215
CsPtCl ₆ + H ₂ O.....	1424	HCl + Cl.....	399
Cs ₂ SO ₄ + CsCl.....	457	HF + KF + H ₂ O.....	804
" + Ce ₂ (SO ₄) ₃ + H ₂ O.....	391	HIO ₃ + KIO ₃ + H ₂ O.....	824
CuBr + CdBr ₂	352	HNO ₃ + KNO ₃	834
CuCN + KCN.....	718	H ₂ O ₂ + NH ₃	1039
CuCl + AgI.....	60	H ₃ PCl ₄ + Mn ₃ (PO ₄) ₂ + H ₂ O.....	1005
" + BaCl ₂	162	H ₂ S + CO ₂	237
" + " + H ₂ O.....	157	" + HCl.....	578
" + CaCl ₂	290	" + NH ₃	1039 1042
" + CdCl ₂	364	H ₂ SO ₄ + Ag ₂ SO ₄	76
CuCl ₂ + CoCl ₂ + H ₂ O.....	406	" + HNO ₃ + H ₂ O.....	583
CuCl + CsCl.....	457	" + H ₂ O ₂	591
" + NH ₄ Cl.....	1093	HfK ₂ F ₆ + H ₂ O.....	809
Cu ₂ S ₂ (SO ₄) ₂ + H ₂ O.....	465	Hf(NH ₄) ₂ F ₆ + H ₂ O.....	1098
CuI + CdI ₂	373	Hg + Mg.....	935
CuK ₂ (SO ₄) ₂ + H ₂ O.....	878	HgBr ₂ + AgNO ₃	69
Cu(NO ₃) ₂ + Co(NO) ₂ + H ₂ O.....	430	HgBr + AlBr ₃	83
" + Pb(NO ₃) ₂ + H ₂ O.....	1402	HgCl + AgCl.....	48
CuRb ₂ (SO ₄) ₂ + H ₂ O.....	1440	HgCl ₂ + AgNO ₃	69

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(For locating results not found by searching the alphabetically arranged tables.)

HgCl ₂ + BaCl ₂ + H ₂ O.....	158-9	KBr + HgBr ₂ + H ₂ O.....	607
" + CaCl ₂ + H ₂ O.....	286	" + LiBr.....	900
" + CoCl ₂ + H ₂ O.....	408	" + PbBr ₂ + H ₂ O.....	1369
" + CsCl + H ₂ O.....	455	KCH ₃ COO + Cu(CH ₃ COO) ₂ + H ₂ O.....	469
" + " + (CH ₃) ₂ CO.....	455	KCN + AgCN + H ₂ O.....	28
" + CuCl ₂ + H ₂ O.....	478-9	" + Cd(CN) ₂ + H ₂ O.....	354
" + HgBr ₂	611	" + Cu(CN) ₂	472
HgCl + KCl.....	782	" + Hg(CN) ₂ + H ₂ O.....	615, 617
" + NH ₄ Cl.....	1093	KCNS + AgCNS + H ₂ O.....	30
HgCl ₂ + TiCl + H ₂ O.....	1548	" + Ba(CNS) ₂ + H ₂ O.....	149
HgCo(SCN) ₄ + NH ₄ Cl + H ₂ O.....	404	K ₂ CO ₃ + CuCO ₃ + H ₂ O.....	474
Hg ₂ CsBr ₃ + H ₂ O.....	451	" + NH ₄ OH + H ₂ O.....	1037
HgI ₂ + AgI.....	60	" + KNO ₃ + H ₂ O.....	838
" + AgNO ₃	69	K ₂ C ₂ O ₄ + (NH ₄) ₂ C ₂ O ₄ + H ₂ O.....	1076
HgI ₂ .CaI ₂ + H ₂ O.....	299	" + UO ₂ C ₂ O ₄ + H ₂ O.....	1563
HgI ₂ + CdCl ₂	364	K ₂ CaFe(CN) ₆ + C ₂ H ₅ OH + H ₂ O.....	262
" + CdI ₂	373	K ₂ Cd(SO ₄) ₂ + H ₂ O.....	379
" + CsI + H ₂ O.....	461	KCl + AgI.....	60
" + HgBr ₂	611	" + AlCl ₃ + H ₂ O.....	84
" + HgCl ₂	639	" + BaCl ₂	162
" + HgCl ₂ + H ₂ O.....	621	" + " + H ₂ O.....	159
" + I.....	678	" + " + CuCl ₂ + H ₂ O.....	157
HgI ₂ .2LiI.6H ₂ O + H ₂ O.....	925	" + BaSO ₄	186
2HgI ₂ .MgI ₂ + H ₂ O.....	975	" + CaCl ₂	290
5HgI ₂ .3MnI ₂ .20H ₂ O.....	1003	" + " + H ₂ O.....	286-7
Hg ₂ SO ₄ + HgBr ₂	611	" + Ca(NO ₃) ₂ + H ₂ O.....	305
" + HgI ₂	648	" + CdCl ₂	364
I + As.....	105	" + " + H ₂ O.....	356-8
" + AsI ₃	106	" + CoCl ₂ + H ₂ O.....	408-9
" + BaI ₂ + H ₂ O.....	167	" + CuCl.....	488
" + Bi.....	199	" + " + H ₂ O.....	478-82
" + Br.....	214	" + CuCl ₂ + (CH ₃) ₂ CO.....	488
" + Cl.....	399	" + CsCl.....	457
" + CsI.....	462	" + CsSO ₄	465
" + " + H ₂ O.....	459-60	" + FeCl ₃ + H ₂ O.....	527
" + " + C ₆ H ₆	461	" + H ₂ O ₂	591
" + " + C ₆ H ₅ CH ₃	461	" + H ₃ BO ₃ + H ₂ O.....	123
" + CuI + H ₂ O.....	490	" + HgCl ₂ + H ₂ O.....	623-4
" + HgI ₂	648	" + HgCl ₂ + (CH ₃) ₂ CO.....	638
" + Sb.....	1468	" + HgCl ₂ + C ₂ H ₅ OH.....	638
" + SbI ₃	1483	" + K ₂ B ₄ O ₇ + K ₂ B ₁₀ O ₁₆ + H ₂ O.....	684
" + Te.....	1526	" + KBr.....	696
In + I.....	678	" + " + H ₂ O.....	688
In ₂ Cs ₂ (SO ₄) ₄ + H ₂ O.....	465	" + KCN.....	718
IrCs ₂ Cl ₆ + H ₂ O.....	455	" + K ₂ CO ₃ + H ₂ O.....	728
IrRb ₂ Cl ₆ + H ₂ O.....	1434	" + K ₂ Cr ₂ O ₇ + H ₂ O.....	801
K + NH ₃	1037	" + K ₂ CO ₃ + H ₂ O.....	730
KAl(SO ₄) ₂ + H ₂ O.....	100-1	" + K ₂ Mg(CO ₃) ₂ + H ₂ O.....	732
KAuCl ₄ + H ₂ O.....	116	" + KNO ₃ + H ₂ O.....	836
KBr + AgBr.....	11	" + " + CaCl ₂ + Ca(NO ₃) ₂ + H ₂ O.....	283
" + AlBr ₃	83	" + LiCl.....	919
" + As ₂ O ₃ + H ₂ O.....	109	" + MgCl ₂	969
" + Br ₂ + H ₂ O.....	209	" + " + H ₂ O.....	961, 1000
" + CaBr ₂	244	" + NH ₄ Cl + ".....	1082
" + CdBr ₂	352	" + NaCl + H ₂ O.....	1223

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(For locating results not found by searching the alphabetically arranged tables.)

KCl + PbCl ₂	1394	KMnV ₅ O ₁₄ ·8H ₂ O.....	1014
" + " + H ₂ O.....	1386-8	K ₂ MoO ₄ + K ₂ CrO ₄	803
" + RbCl + MgCl ₂	968	" + " + H ₂ O.....	799
" + Rb ₂ SO ₄	1440	KNO ₃ + AgNO ₃	69
2KCl·UO ₂ Cl ₂ + H ₂ O.....	1563	" + " + H ₂ O.....	63
KClO ₃ + CaCl ₂ + H ₂ O.....	287	" + Al(NO ₃) ₃ + H ₂ O.....	93
" + Ca(ClO ₃) ₂ + H ₂ O.....	295	" + Ba(NO ₃) ₂	175
" + KBr + H ₂ O.....	689	" + " + H ₂ O.....	171
" + KBrO ₃ + H ₂ O.....	697	" + CaCl ₂ + H ₂ O.....	287
" + K ₂ CO ₃ + H ₂ O.....	729	" + Ca(NO ₃) ₂	309
" + KCl + H ₂ O.....	751	" + " + H ₂ O.....	304-5
KClO ₄ + KF ₄ B + H ₂ O.....	685	" + Fe(NO ₃) ₃ + H ₂ O.....	534
KClO ₃ + TiClO ₃ + H ₂ O.....	1551	" + KBr.....	696
K ₂ CrO ₄ + KCl.....	782	" + H ₂ O.....	690
K ₂ CrO ₄ + La ₂ (CrO ₄) ₃ + H ₂ O.....	890	" + KBrO ₃ + H ₂ O.....	698
K ₂ CrO ₄ ·MgCrO ₄ + H ₂ O.....	969	" + KCl + H ₂ O.....	753-7
K ₂ Cr ₂ (SO ₄) ₄ + H ₂ O.....	449	" + " + CaCl ₂ + H ₂ O.....	283
K ₂ Co(CO ₃) ₂ + K ₂ CO ₃ + H ₂ O.....	405	" + " + HCl + H ₂ O.....	750
K[Co(NH ₃) ₂ (NO ₂) ₄] + H ₂ O.....	422,	" + KClO ₃ + H ₂ O.....	785
KF + AlF ₃	90	" + KClO ₄ + H ₂ O.....	791
KF·BeF ₂ + H ₂ O.....	191	" + KIO ₃ + H ₂ O.....	825
KF + CaF ₂ + H ₂ O.....	366	" + NH ₄ Cl + H ₂ O.....	1082
" + CoF ₂ + H ₂ O.....	418	" + NH ₄ NO ₃ + H ₂ O.....	1111
" + CuF ₂ + H ₂ O.....	490	" + NaCl + H ₂ O.....	1223
" + KBr.....	696	" + NaNO ₃ + H ₂ O.....	1277
" + KCl.....	782	" + Pb(NO ₃) ₂ + H ₂ O.....	1401
" + NiF ₂ + H ₂ O.....	1345	KNO ₃ ·UO ₂ (NO ₃) ₂ + H ₂ O.....	1567
KH ₂ AsO ₄ + H ₃ BO ₃ + H ₂ O.....	125	KOC ₆ H ₄ (NO ₂) ₃ + TiOC ₆ H ₄ (NO ₂) ₃ + H ₂ O.....	1540
KHCO ₃ + MgCO ₃ + H ₂ O.....	955	K ₂ O + B ₂ O.....	118
KH ₂ PO ₄ + H ₃ BO ₃ + H ₂ O.....	123	KOH + KBr.....	696
" + KCl + H ₂ O.....	759	" + K ₂ CO ₃ + H ₂ O.....	728
K ₂ HfF ₆ + HF + H ₂ O.....	605	" + KCl.....	782
KI + AgCl.....	48	" + " + H ₂ O.....	758-9
" + As ₂ O ₃ + H ₂ O.....	109	" + KNO ₃	850
" + CaI ₂	373	" + " + H ₂ O.....	837
" + BiI ₃ + H ₂ O.....	201	KPO ₃ + KCl.....	782
" + CaI ₂ + H ₂ O.....	367-8	K ₃ PO ₄ + ".....	782
" + HgI ₂ + H ₂ O.....	641-2	K ₂ Pt(CN) ₄ + PtLi ₂ (CN) ₄ + H ₂ O.....	908
" + HgF ₂ + C ₂ H ₅ OH.....	643	K ₂ PtCl ₆ + H ₂ O.....	1424
" + " + (CH ₃) ₅ CO.....	643	K ₂ Rb ₂ (ClO ₄) ₃ + H ₂ O.....	1436
" + " + (C ₂ H ₅) ₂ O.....	644	K ₂ SO ₄ + Ag ₂ SO ₄	76
" + I.....	678	" + Al ₂ (SO ₄) ₃ + H ₂ O.....	98
" + " + H ₂ O.....	659-60	" + BaSO ₄	184
" + KBr.....	696	" + BeSO ₄ + H ₂ O.....	195
" + KBrO ₃ + H ₂ O.....	698	" + Bi ₂ (SO ₄) ₃ + H ₂ O.....	205
" + KCl.....	782	" + CaSO ₄	344
" + " + H ₂ O.....	752	" + " + H ₂ O.....	335-6
KI + KClO ₃ + H ₂ O.....	787	" + CdSO ₄	385
" + PbI ₂ + H ₂ O.....	1399	" + " + H ₂ O.....	380
KIO ₃ + KBr + H ₂ O.....	690	" + Ce ₂ (SO ₄) ₃ + H ₂ O.....	392-3
" + KCl + H ₂ O.....	754	" + CoCl ₂ + H ₂ O.....	409
" + KClO ₄ + H ₂ O.....	787	" + CoSO ₄ + H ₂ O.....	435
" + KF ₄ B + H ₂ O.....	685	" + CsCl.....	457
K ₂ IrCl ₆ + H ₂ O.....	680	" + Cs ₂ SO ₄	465
KMgFe(CN) ₆ + H ₂ O.....	951	" + CuSO ₄ + H ₂ O.....	505-6
KMnO ₄ + KClO ₄ + H ₂ O.....	791	" + Di ₂ (SO ₄) ₃ + H ₂ O.....	518
" + KF ₄ B + H ₂ O.....	685	" + H ₃ BO ₃ + H ₂ O.....	123

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(For locating results not found by searching the alphabetically arranged tables.)

$K_2SO_4 + H_2O_2$	591	$LiCl + LiBr$	900
" + $Fe_2(SO_4)_3 + H_2O$	544	" + NH_4Cl	1093
" + $KBrO_3 + H_2O$	698	" + $PbCl_2 + H_2O$	1388
" + $K_2CO_3 + H_2O$	732	$LiF + AlF_3$	90
" + KCl	782	" + $LiBO_2$	898
" + $KCl + H_2O$	760-1	" + $LiBr$	900
" + $KClO_3 + H_2O$	787	" + $LiCl$	919
" + K_2CrO_4	803	$LiI + BiI_3 + H_2O$	201
" + " + H_2O	799-800	" + I	678
" + $K_4Fe(CN)_6 + H_2O$	722	$LiNO_3 + AgNO_3$	69
" + KI	823	" + $Ba(NO_3)_2$	175
" + " + H_2O	814	" + $Ca(NO_3)_2$	309
" + $KIO_3 + H_2O$	825	" + KNO_3	850
" + $KMnO_4 + H_2O$	827	$LiOH + LiBr$	900
" + $K_2MoO_4 + H_2O$	830	" + $LiCl$	919
" + $KNO_3 + H_2O$	838-40	$Li_2SO_4 + Al_2(SO_4)_3 + H_2O$	102
" + " + $KCl + H_2O$	756	" + $BaSO_4$	184
" + $La_2(SO_4)_3 + H_2O$	895	" + $Bi_2(SO_4)_3 + H_2O$	205
" + Li_2SO_4	933	" + $CdSO_4$	385
" + " + H_2O	934	" + " + H_2O	381
" + $Mg(NO_3)_2 + H_2O$	979	" + $CaSO_4$	344
" + $MgSO_4$	995	" + $CaSiO_3$	347
" + $NH_4Cl + H_2O$	1082	" + $CuSO_4 + H_2O$	507
" + $Na_2CO_3 + Na_2SO_4 + H_2O$	736	" + $FeSO_4 + H_2O$	545
" + $Nd(SO_4)_3 + H_2O$	1339	" + $LiCl + H_2O$	913
" + $NiSO_4 + H_2O$	1350	" + $LiNO_3$	929
" + $PbSO_4$	1416	$Li_2SiO_3 + LiBO_2$	898
" + $Tl_2SO_4 + H_2O$	1557	$Mg_3Bi_2(NO_3)_{12} + H_2O$	203
$K_2SO_4 + UO_2SO_4 + H_2O$	1568	$MgBr_2 + AlBr_3$	83
$K_2S_2O_8 + BaS_2O_4 + H_2O$	187	" + $KCl + H_2O$	766
$K_2SeO_4 + CaSeO_4 + H_2O$	345	" + $LiBr$	900
$K_2SiF_6 + H_2O$	1488	$MgC_2O_4 + (NH_4)_2C_2O_4 + H_2O$	1076
$K_2TaF_7 + KF + H_2O$	1525	$MgC_8H_4O_4 + Li_2C_8H_4O_4 + H_2O$	905
$K_2WO_4 + K_2CrO_4$	803	$Mg_3Ce(NO_3)_6 + H_2O$	389
" + K_2SO_4	879	$MgCl_2 + AgCl$	48
$La(C_2O_4)_3 + La(NO_3)_3 + H_2O$	893	" + $BaCl_2$	162
$La(CrO_4)_3 + 3(NH_4)_2CrO_4 + H_2O$	800	" + $BeCl_2$	190
$Li + NH_3$	1042	" + $CaCl_2$	290
$LiAuCl_4 + H_2O$	116	" + " + H_2O	288-9
$LiBr + AlBr_3$	83	" + $CdCl_2$	304
" + $As_2O_3 + H_2O$	109	" + " + H_2O	359
" + $CaBr_2$	244	" + $CoCl_2 + H_2O$	411
$Li_2CO_3 + CaCO_3$	279	" + $CsCl + H_2O$	455
$Li_2C_2O_4 + (NH_4)_2C_2O_4 + H_2O$	1076	" + $FeCl_2 + KCl + H_2O$	527
$LiCl + AgCl$	48	" + HCl	578
" + AgI	60	" + $HgCl_2 + H_2O$	625
" + $As_2O_3 + H_2O$	109	" + $KBr + H_2O$	689
" + $BaCl_2$	162	" + KCl	782
" + $BeCl_2$	190	$MgCl_2 + KCl + H_2O$	764-6
" + $CaCl_2$	290	" + " + $CaCl_2 + H_2O$	287
" + $CdCl_2$	364	" + $LiCl$	919
" + $CoCl_2$	417	" + $NaCl + H_2O$	1224
" + " + H_2O	410-11	" + " + salts + H_2O	1220
" + $CsCl$	457	" + $TlCl + H_2O$	1548
" + $CuCl$	488	$MgCo(NH_3)_2(NO_3)_2(C_2O_4)_2 + H_2O$	423
" + $CuCl_2 + H_2O$	483	$MgCs_2(SO_4)_2 + H_2O$	465
" + KCl	782	$MgF_2 + CaF_2$	297

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(For locating results not found by searching the alphabetically arranged tables.)

$Mg_3[Gd(NO_3)_6]_2 + HNO_3$	549	$(NH_3)_5IrBr_3 + H_2O$	68
$MgK_2(CO_3)_2 + KCl + H_2O$	732	$(NH_4)_2Al_2(SO_4)_4 + H_2O$	10
$Mg_3[La(NO_3)_6]_2 + H_2O + HNO_3$	894	$(NH_4)_3AlF_6 + H_2O$	9
$MgNH_4AsO_4 \cdot 6H_2O + H_2O$	1044	$NH_4BePO_4 + H_2O$	19
$Mg(NO_3)_2 + KNO_3 + H_2O$	841	$NH_4Br + AlBr_3$	8
" + $La(NO_3)_3$	894	" + $As_2O_3 + H_2O$	10
" + " + H_2O	893	$NH_4Br \cdot CdBr_2 + H_2O$	35
" + $MgCl_2 + H_2O$	962-3	$NH_4Br + CoBr_2 + H_2O$	40
" + $Mg(IO_3)_2 + H_2O$	976	" + $FeBr_2 + H_2O$	52
$Mg_3[Nd(NO_3)_6]_2 \cdot 24H_2O$	1332	" + $KBr + H_2O$	69
$MgO + BaO$	179	" + NH_3	104
" + CaO	309	$NH_4CNS + AgCNS + H_2O$	3
$Mg_3[Pr(NO_3)_6]_2 + H_2O$	1420	" + $Ba(CNS)_2 + H_2O$	14
" + HNO_3	1421	" + NH_3	104
$MgRh_2(SO_4)_2 + H_2O$	1440	" + $NH_4NO_3 + H_2O$	110
$MgSO_4 + CuSO_4 + H_2O$	507	$(NH_4)_2CO_3 \cdot MgCO_3 + H_2O$	95
" + $K_2SO_4 + H_2O$	864-7	$(NH_4)_2C_2O_4 + K_2C_2O_4 + H_2O$	74
" + $MgCl_2$	969	" + $UO_2C_2O_4 + H_2O$	156
" + " + H_2O	961, 963-4	$(NH_4)_2CaFe(CN)_6 + C_2H_5OH + H_2O$	26
" + " + $NaCl + H_2O$	966-7	$NH_4Cl + AgCl$	4
" + $Mg(NO_3)_2 + H_2O$	978-9	" + $BaCl_2 + H_2O$	15
$MgS_2O_6 + BaS_2O_6 + H_2O$	187	" + " + $CuCl_2 + H_2O$	15
$MgSeO_4 + K_2SeO_4 + H_2O$	884	" + $CdCl_2 + H_2O$	36
$MgSiO_3 + CaSiO_3$	347	" + $CoCl_2 + H_2O$	411-
$Mn_2Bi_2(NO_3)_{12} + H_2O$	203	" + $CuCl_2 + H_2O$	48
$MnBr_2 + AlBr_3$	83	$NH_4Cl \cdot CuCl_2 + C_2H_5OH$	48
$Mn_3[Ce(NO_3)_6]_2 + H_2O$	389	$NH_4Cl + FeCl_3 + H_2O$	528-
$MnCl_2 + BaCl_2$	162	" + $HgCl_2$	63
" + $CaCl_2$	290	" + " + H_2O	62
" + $CdCl_2$	364	" + KCl	78
" + $FeCl_2$	531	" + " + H_2O	767-
" + $LiCl$	919	" + " + $HgCl_2 + H_2O$	623, 624
" + " + H_2O	914	" + $MgCl_2 + H_2O$	964-
" + $MgCl_2$	969	" + $MnCl_2 + H_2O$	100
$MnCs_2(SO_4)_2 + H_2O$	465	" + NH_3	104
$Mn_3[La(NO_3)_6]_2 + HNO_3 + H_2O$	891	" + $(NH_4)_2B_4O_7 + H_2O$	104
$Mn(NO_3)_2 + La(NO_3)_3 + H_2O$	893	" + $NH_4HCO_3 + H_2O$	1071, 107
" + $Mg(NO_3)_2 + H_2O$	980	" + $(NH_4)_2CO_3 + H_2O$	107
$Mn_3[Nd(NO_3)_6]_2 \cdot 24H_2O$	1332	" + $NH_4C_2O_4 + H_2O$	107
$Mn_3[Pr(NO_3)_6]_2 + H_2O$	1421	" + $Na_2B_4O_7 + H_2O$	104
$MnRb_2(SO_4)_2 + H_2O$	1440	" + $NaCl + H_2O$	1047, 1073, 1223, 12
$MnSO_4 + Al_2(SO_4)_3 + H_2O$	102	" + $Na_2Cr_2O_7 + H_2O$	128
" + $CaSO_4 + H_2O$	381	" + $PbCl_2 + H_2O$	1389-
" + $CuSO_4 + H_2O$	505, 508	$2NH_4Cl \cdot UO_2Cl_2 + H_2O$	156
" + $FeSO_4 + H_2O$	545	$NH_4ClO_4 + Al(ClO_4)_3 + H_2O$	8
" + $K_2SO_4 + H_2O$	868-9	" + $Cu(ClO_4)_2 + H_2O$	4
" + Li_2SO_4	933	" + NH_3	104
" + $MgSO_4 + H_2O$	987	$(NH_4)_2CrO_4 + K_2CrO_4 + H_2O$	80
$MnSiO_3 + CaSiO_3$	347	$(NH_4)_2Cr_2O_7 + NH_4Cl + H_2O$	107
" + $MgSiO_3$	996	" + $Na_2Cr_2O_7 + H_2O$	122
$MoO_3 + PbO$	1407	$(NH_4)_2Cr_2(SO_4)_4 + H_2O$	4
$NH_2COC_2H_5 + CaCl_2 + H_2O$	292	$NH_4F + BeF_2 + H_2O$	19
$(NH_2)_2CO_2 + NH_3$	1042	" + $CdF_2 + H_2O$	36
$NH_3 + AlBr_3$	83	" + $CoF_2 + H_2O$	4
" + H_2O_2	591	" + $CuF_2 + H_2O$	48
" + H_2S	598	" + $NiF_2 + H_2O$	134
$(NH_3)_4Au(NO_3)_3 + H_2O$	117	$NH_4Ga(SO_4)_2 + H_2O$	

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(For locating results not found by searching the alphabetically arranged tables.)

$\text{NH}_4\text{HCO}_3 + \text{NaHCO}_3 + \text{H}_2\text{O}$	1205	$(\text{NH}_4)_2\text{SO} + (\text{NH}_4)_2\text{B}_4\text{O}_7 + \text{H}_2\text{O}$	1047-9
$\text{NH}_4\text{H}_2\text{PO}_4 + \text{KH}_2\text{PO}_4 + \text{H}_2\text{O}$	855	" + $\text{NH}_4\text{C}_2\text{O}_4 + \text{H}_2\text{O}$	1076
" + $\text{NH}_4\text{Cl} + \text{H}_2\text{O}$	1082	" + $\text{NH}_4\text{HCO}_3 + \text{H}_2\text{O}$	1072-3
" + $\text{NaCl} + \text{H}_2\text{O}$	1082	" + $\text{NH}_4\text{Cl} + \text{H}_2\text{O}$	1082-3
" + $\text{Na}_2\text{HPO}_4 + \text{H}_2\text{O}$	1082	" + $\text{NH}_4\text{ClO}_4 + \text{H}_2\text{O}$	1095
$(\text{NH}_4)_2\text{HfF}_6 + \text{H}_2\text{O}$	605	" + $(\text{NH}_4)_2\text{CrO}_4 + \text{H}_2\text{O}$	1097
$\text{NH}_4\text{I} \cdot \text{CdI}_2 + \text{H}_2\text{O}$	369	" + NH_4NO_3	1115
$2\text{NH}_4\text{I} \cdot \text{HgI}_2 + \text{H}_2\text{O}$	648	" + " + H_2O	1108-9
$\text{NH}_4\text{I} + \text{NH}_3$	1042	" + $\text{Nd}_2(\text{SO}_4)_3 + \text{H}_2\text{O}$	1334
" + $\text{PbI}_2 + \text{H}_2\text{O}$	1399	$(\text{NH}_4)_2\text{S}_2\text{O}_6 + \text{BaS}_2\text{O}_6 + \text{H}_2\text{O}$	187
" + $\text{SbI}_3 + \text{H}_2\text{O}$	1482	" + $\text{CuS}_2\text{O}_6 + \text{H}_2\text{O}$	517
$\text{NH}_4\text{In}(\text{SO}_4)_4 + \text{H}_2\text{O}$	680	$(\text{NH}_4)_2\text{SeO}_4 + \text{CaSeO}_4 + \text{H}_2\text{O}$	345
$(\text{NH}_4)_2\text{IrCl}_6 + \text{H}_2\text{O}$	680-1	" + $\text{MgSeO}_4 + \text{H}_2\text{O}$	995
$(\text{NH}_4)_2\text{La}(\text{NO}_3)_4 + \text{H}_2\text{O}$	894	$(\text{NH}_4)_2\text{ZrF}_6 + \text{H}_2\text{O}$	1598
$\text{NH}_4\text{LiC}_4\text{H}_4\text{O}_6 + \text{H}_2\text{O}$	902-3	$\text{N}_2\text{O} + \text{Br}$	214
$\text{NH}_4\text{LiSO}_4 + \text{H}_2\text{O}$	933	$\text{N}_2\text{O}_2 + \text{CCl}_4$	216
$(\text{NH}_4)_2\text{MgFe}(\text{CN})_6 + \text{H}_2\text{O}$	951	$\text{Na} + \text{NH}_3$	1042
$\text{NH}_4\text{MgPO}_4 + \text{H}_2\text{O}$	984	$\text{Na}_3\text{AlF}_6 + \text{salts} + \text{H}_2\text{O}$	90
$(\text{NH}_4)_2\text{Mg}(\text{SO}_4)_2 + \text{H}_2\text{O}$	988	$\text{Na}_2\text{Al}_2(\text{SO}_4)_4 + \text{H}_2\text{O}$	104
$\text{NH}_4\text{MnF}_3 + \text{H}_2\text{O}$	1003	$\text{NaAuCl}_4 + \text{H}_2\text{O}$	116
$\text{NH}_4\text{MnPO}_4 \cdot 7\text{H}_2\text{O}$	1005	$\text{NaBO}_2 + \text{LiBO}_2$	898
$\text{NH}_4\text{NO}_3 + \text{AgNO}_3$	69	$\text{Na}_2\text{B}_4\text{O}_7 + \text{KCl} + \text{NaCl} + \text{H}_2\text{O}$	761
" + $\text{AgNO}_3 + \text{H}_2\text{O}$	64	" + $(\text{NH}_4)_2\text{B}_4\text{O}_7$	1047-9
" + $\text{Ba}(\text{NO}_3)_2 + \text{H}_2\text{O}$	172	" + $\text{NH}_4\text{Cl} + \text{H}_2\text{O}$	1047
$2\text{NH}_4\text{NO}_3 \cdot \text{Ce}(\text{NO}_3)_4 + \text{H}_2\text{O}$	390	" + $\text{NaCl} + \text{H}_2\text{O}$	1047
$\text{NH}_4\text{NO}_3 + \text{Cu}(\text{NO}_3)_2 + \text{H}_2\text{O}$	493	$\text{NaBr} + \text{AgBr}$	186
" + KCl	782	" + AlBr_3	83
" + " + H_2O	757	" + $\text{As}_2\text{O}_3 + \text{H}_2\text{O}$	109
" + KNO_3	850	" + CaBr_2	244
" + " + H_2O	842	" + $\text{CdBr}_2 + \text{H}_2\text{O}$	351
" + K_2SO_4	879	" + ".....	352
" + LiCl	919	" + LiBr	900
$2\text{NH}_4\text{NO}_3 \cdot \text{Mg}(\text{NO}_3)_2 + \text{H}_2\text{O}$	980	" + $\text{Na}_2\text{CO}_3 + \text{H}_2\text{O}$	1201
$\text{NH}_4\text{NO}_3 + \text{NH}_3$	1042	$\text{NaBrO}_3 + \text{NaBr} + \text{H}_2\text{O}$	1157
" + NH_4Cl	1093	$\text{NaCN} + \text{KCN}$	718
" + " + H_2O	1080-2	$\text{NaCNS} + \text{AgCNS} + \text{H}_2\text{O}$	30
" + NH_4HCO_3	1071	" + $\text{Ba}(\text{CNS})_2 + \text{H}_2\text{O}$	149
" + $\text{NH}_4\text{C}_2\text{O}_4 + \text{H}_2\text{O}$	1076	$\text{Na}_2\text{CO}_3 + \text{CaCO}_3$	276
$\text{NH}_4\text{NO}_3 \cdot \text{UO}_2(\text{NO}_3)_2 + \text{H}_2\text{O}$	1567	$\text{Na}_2\text{CO}_3 + \text{K}_2\text{CO}_3 + \text{H}_2\text{O}$	732-4
$(\text{NH}_4)_2\text{PtCl}_6 + \text{H}_2\text{O}$	1429	" + " + $\text{Na}_2\text{SO}_4 + \text{H}_2\text{O}$	736
" + $(\text{NH}_4)_2\text{IrCl}_6 + \text{H}_2\text{O}$	680	" + $\text{KCl} + \text{H}_2\text{O}$	730
$(\text{NH}_4)_2\text{SO}_4 + \text{Al}_2(\text{SO}_4)_3 + \text{H}_2\text{O}$	103	" + $\text{KClO}_3 + \text{H}_2\text{O}$	729
" + $\text{BeSO}_4 + \text{H}_2\text{O}$	195	" + $(\text{NH}_4)_2\text{CO}_3 + \text{H}_2\text{O}$	1070
" + $\text{Bi}_2(\text{SO}_4)_3 + \text{H}_2\text{O}$	205	" + $\text{NaCl} + \text{Na}_2\text{B}_2\text{O}_4 + \text{H}_2\text{O}$	1153
" + $\text{CaSO}_4 + \text{H}_2\text{O}$	338-9	$\text{Na}_2\text{C}_2\text{O}_4 + \text{CuC}_2\text{O}_4 + \text{H}_2\text{O}$	475
" + $\text{CdSO}_4 + \text{H}_2\text{O}$	381-2	" + $\text{K}_2\text{C}_2\text{O}_4 + \text{H}_2\text{O}$	744
" + $\text{Ce}(\text{SO}_4)_3 + \text{H}_2\text{O}$	393-4	" + $\text{MgC}_2\text{O}_4 + \text{H}_2\text{O}$	958
" + $\text{CoSO}_4 + \text{H}_2\text{O}$	436-7	" + $(\text{NH}_4)_2\text{C}_2\text{O}_4 + \text{H}_2\text{O}$	1077
" + $\text{CuSO}_4 + \text{H}_2\text{O}$	505, 509-12	$\text{NaCl} + \text{BaCl}_2$	162
" + $\text{FeSO}_4 + \text{H}_2\text{O}$	545	" + " + H_2O	160
" + $\text{Fe}_2(\text{SO}_4)_3 + \text{H}_2\text{O}$	546	" + " + $\text{HCl} + \text{H}_2\text{O}$	158
" + $\text{KCl} + \text{H}_2\text{O}$	763	" + " + $\text{CuCl}_2 + \text{H}_2\text{O}$	157
" + $\text{K}_2\text{SO}_4 + \text{H}_2\text{O}$	843, 869-71	" + $\text{Ba}(\text{NO}_3)_2 + \text{H}_2\text{O}$	156
" + $\text{La}_2(\text{SO}_4)_3 + \text{H}_2\text{O}$	895	" + BaSO_4	186
" + $\text{Li}_2\text{SO}_4 + \text{H}_2\text{O}$	933	" + BeCl_2	190
" + $\text{MgSO}_4 + \text{H}_2\text{O}$	987-8	" + $\text{BiCl}_3 + \text{H}_2\text{O}$	201
" + $\text{MnSO}_4 + \text{H}_2\text{O}$	1007-8	" + CaCl_2	290

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NaCl + CaCl ₂ + H ₂ O.....	290	NaCl + RbCl.....	1434
" + CdCl ₂	364	NaClO ₃ + Ba(ClO ₃) ₂ + H ₂ O.....	163
" + " + H ₂ O.....	362	" + K ₂ CO ₃ + H ₂ O.....	729
" + CoCl ₂ + H ₂ O.....	408, 412-3	" + KCl + H ₂ O.....	751
" + CsCl.....	457	" + KClO ₄ + H ₂ O.....	785, 788
" + CuCl.....	488	" + NaBrO ₃ + H ₂ O.....	1163
" + " + H ₂ O.....	485	" + Na ₂ CO ₃ + H ₂ O.....	1206
" + FeCl ₃ + H ₂ O.....	529	" + NaCl + H ₂ O.....	1225, 1250
" + FeCl ₂ + KCl + H ₂ O.....	527	NaClO ₄ + Al(ClO ₄) ₃ + H ₂ O.....	89
" + H ₃ BO ₃ + H ₂ O.....	123	" + KClO ₄ + H ₂ O.....	791
" + HCl.....	578	" + NaCl + H ₂ O.....	1226
" + H ₂ O ₂	591	Na ₂ Cr ₂ O ₇ + K ₂ Cr ₂ O ₇	803
" + HgCl ₂ + H ₂ O.....	626	" + " + H ₂ O.....	801
" + " + CH ₃ COOC ₂ H ₅	638	" + (NH ₄) ₂ Cr ₂ O ₄ + H ₂ O.....	1098
" + KBr.....	696	Na ₂ CrO ₄ + NaCl.....	1249
" + KCl.....	782	Na ₂ Cr ₂ O ₇ + NaCl + H ₂ O.....	1226
" + " + H ₂ O.....	770-3, 757, 840	Na ₂ Cu(CO ₃) ₂ + NaHCO ₃ + H ₂ O.....	474
" + " + HCl + H ₂ O.....	749	NaF + AlF ₃	90
" + KClO ₄ + H ₂ O.....	792-3	NaF, BeF ₂ + H ₂ O.....	191
" + KI.....	823	NaF + CaF ₂	297
" + KNO ₃ + H ₂ O.....	843	" + CdF ₂	366
" + K ₂ SO ₄	879	" + H ₂ O ₂	591
" + " + H ₂ O.....	761-2	" + MgF ₂	970
" + LiCl.....	919	" + NaBr.....	1163
" + " + H ₂ O.....	915	" + NaCl.....	1249
" + MgCl ₂	969	" + " + H ₂ O.....	1227
" + " + H ₂ O.....	966	" + PbF ₂	1397
" + " + Na ₂ SO ₄ + H ₂ O.....	965-7	Na ₄ Fe(CN) ₆ + K ₄ Fe(CN) ₆ + H ₂ O.....	722
" + (NH ₄) ₂ B ₄ O ₇ + H ₂ O.....	1047	NaH ₂ AsO ₄ + H ₃ BO ₃ + H ₂ O.....	125
" + NH ₄ Cl.....	1093	Na ₂ HAsO ₄ + H ₂ O.....	112
" + " + H ₂ O.....	1073, 1047, 1082-4	NaHCO ₃ + K ₂ CO ₃ + H ₂ O.....	735
" + " + NaHCO ₃ + H ₂ O.....	1072	" + KHCO ₃ + H ₂ O.....	735
" + NH ₄ NO ₃	1115	" + NH ₄ HCO ₃ + H ₂ O.....	1071-2, 1074
" + " + H ₂ O.....	1109	" + NaCl + H ₂ O.....	1074, 1225
" + (NH ₄) ₂ HPO ₄ + H ₂ O.....	1082	" + " + Na ₂ B ₂ O ₄	1153
" + Na ₂ B ₄ O ₇ + H ₂ O.....	1047	" + NaNO ₃ + H ₂ O.....	1274
" + Na ₂ O.5B ₂ O ₃ + H ₂ O.....	1152	Na ₂ H(NH ₄)(SO ₃) ₂ + H ₂ O.....	1121
" + Na ₂ B ₂ O ₄ + Na ₂ B ₄ O ₇ + H ₂ O.....	1153	NaH ₂ PO ₄ + CaC ₆ H ₁₁ O ₇ + H ₂ O.....	256
" + " + Na ₂ CO ₃	1153	" + H ₂ BO ₃ + H ₂ O.....	124
" + NaBr.....	1163	" + NH ₄ Cl + H ₂ O.....	1082
" + " + H ₂ O.....	1157	" + NH ₄ H ₂ PO ₄ + H ₂ O.....	1082
" + " + NH ₃	1163	" + NaCl + H ₂ O.....	1082
" + NaBrO ₃ + H ₂ O.....	1164	" + Na ₂ B ₄ O ₇ + NaCl + H ₂ O.....	1154
" + Na ₂ CO ₃ + H ₂ O.....	1201-2	NaI + AgI.....	60
" + NaHCO ₃ + H ₂ O.....	1074, 1203, 1205	" + BiI ₃ + H ₂ O.....	201
" + NaHCO ₃ + Na ₂ CO ₃	1200	2NaI. CaI ₂ + H ₂ O.....	369
" + Na ₂ CO ₃ + Na ₂ SO ₄ + H ₂ O.....	1204	NaI + CdI ₂	373
" + " + NaOH + H ₂ O.....	1205-6	" + KI + H ₂ O.....	814
" + " + KCl + H ₂ O.....	730	" + NaBr.....	1163
" + Na ₂ C ₂ O ₄ + H ₂ O.....	1215	" + Na ₂ CO ₃ + H ₂ O.....	1201
" + NaClO ₄ + H ₂ O.....	1253	" + NaCl + H ₂ O.....	1229, 1249
" + NaNO ₃ + H ₂ O.....	1278	" + NaF.....	1260
" + Na ₂ HPO ₄ + H ₂ O.....	1082	" + SbI ₃ + H ₂ O.....	1482
" + Na ₃ PO ₄ + Na ₂ B ₂ O ₄ + H ₂ O.....	1153	NaIO ₃ + Ca(IO ₃) ₂ + H ₂ O.....	301
" + Na ₂ SO ₄ + H ₂ O.....	1307	" + KIO ₃ + H ₂ O.....	824
" + PbCl ₂	1349	" + Mg(IO ₃) ₂ + H ₂ O.....	976
" + " + H ₂ O.....	1391	" + Na ₂ CO ₃ + H ₂ O.....	1207

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$\text{NaIO}_3 + \text{Na}_2\text{C}_2\text{O}_4 + \text{H}_2\text{O}$	1216	$\text{Na}_2\text{SO}_4 + \text{CaSO}_4$	344
" + $\text{NaBr} + \text{H}_2\text{O}$	1158	" + " + H_2O	341-2
" + $\text{NaCl} + \text{H}_2\text{O}$	1228	" + CdSO_4	385
" + $\text{NaClO}_3 + \text{H}_2\text{O}$	1252	" + " + H_2O	383-4
" + $\text{NaI} + \text{H}_2\text{O}$	1263	" + $\text{Ce}(\text{SO}_4)_3 + \text{H}_2\text{O}$	395
$\text{Na}_2\text{IrCl}_6 + \text{H}_2\text{O}$	681	" + $\text{CoSO}_4 + \text{H}_2\text{O}$	438-9
$\text{NaKC}_4\text{H}_4\text{O}_6 + \text{H}_2\text{O}$	707	" + $\text{Cs}_2\text{SO}_4 + \text{H}_2\text{O}$	465
$\text{NaKS}_2\text{O}_3 + \text{H}_2\text{O}$	881	" + $\text{CuSO}_4 + \text{H}_2\text{O}$	513-4
$\text{Na}_2\text{KH}(\text{SO}_3)_2 + \text{H}_2\text{O}$	859	" + $\text{FeSO}_4 + \text{H}_2\text{O}$	546-7
$\text{Na}_2\text{MoO}_4 + \text{La}_2(\text{MoO}_4)_3 + \text{H}_2\text{O}$	891	" + $\text{Gd}_2(\text{SO}_4)_3 + \text{H}_2\text{O}$	550
$\text{NaNO}_2 + \text{KNO}_2$	833	" + $\text{H}_3\text{BO}_3 + \text{H}_2\text{O}$	123
" + NaBr	1163	" + KCl	782
" + NaCl	1249	" + " + H_2O	761
$\text{NaNO}_3 + \text{AgNO}_3 + \text{H}_2\text{O}$	65	" + " + $\text{K}_2\text{O}_3 + \text{H}_2\text{O}$	761
" + $\text{Al}(\text{NO}_3)_3 + \text{H}_2\text{O}$	92	" + $\text{KMnO}_4 + \text{H}_2\text{O}$	827
" + $\text{BaCl}_2 + \text{H}_2\text{O}$	156	" + K_2SO_4	879
" + $\text{Ba}(\text{NO}_3)_2$	175	" + " + H_2O ...757, 840, 870,	872
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" + $\text{CO}(\text{NH}_2)_2 + \text{NH}_4\text{NO}_3$	1114	" + $\text{La}_2(\text{SO}_4)_3 + \text{H}_2\text{O}$	896
" + $\text{Ca}(\text{NO}_3)_2$	309	" + Li_2SO_4	933
" + $\text{Ca}(\text{NO}_3)_2 + \text{H}_2\text{O}$	306	" + " + H_2O	934
" + $\text{CaS}_2\text{O}_3 + \text{Ca}(\text{NO}_3)_2 + \text{H}_2\text{O}$...	344	" + MgSO_4	995
" + $\text{Cu}(\text{NO}_3)_2 + \text{H}_2\text{O}$	492	" + " + H_2O	988-99
" + H_2O_2	591	" + $\text{MnSO}_4 + \text{H}_2\text{O}$	1008-10
" + $\text{KCl} + \text{H}_2\text{O}$	757	" + NH_4NO_3	1115
" + $\text{KClO}_3 + \text{H}_2\text{O}$	791-2	" + $(\text{NH}_4)_2\text{SO}_4 + \text{H}_2\text{O}$	1124-5
" + KNO_3	850	" + $\text{Na}_2\text{B}_4\text{O}_7 + \text{H}_2\text{O}$	1049, 1154-5
" + " + H_2O	840, 844-5	" + NaBr	1163
" + LiNO_3	929	" + $\text{NaBrO}_3 + \text{H}_2\text{O}$	1164-5
" + $\text{MgCl}_2 + \text{H}_2\text{O}$	965	" + $\text{NaC}_8\text{H}_4\text{O}_4 + \text{H}_2\text{O}$	1180
" + $\text{Mg}(\text{NO}_3)_2 + \text{H}_2\text{O}$	980	" + $\text{Na}_2\text{CO}_3 + \text{H}_2\text{O}$	1209-10
" + NH_4Cl	1093	" + " + NaHCO_3	1200
" + NH_4NO_3	1115	" + $\text{Na}_2\text{C}_2\text{O}_4 + \text{H}_2\text{O}$	1215
" + " + H_2O	1110	" + NaCl	1249
" + $\text{Na}_2\text{CO}_3 + \text{H}_2\text{O}$	1207	" + " + H_2O	1234-6
" + $\text{Na}_2\text{C}_2\text{O}_4 + \text{H}_2\text{O}$	1215	" + " + $\text{MgCl}_2 + \text{H}_2\text{O}$	965-6
" + $\text{NaBr} + \text{H}_2\text{O}$	1158	" + " + salts + H_2O	1220
" + $\text{NaBrO}_3 + \text{H}_2\text{O}$	1164	" + $\text{NaClO}_3 + \text{H}_2\text{O}$	1251
" + $\text{NaCl} + \text{H}_2\text{O}$	1229-30	" + $\text{NaClO}_4 + \text{H}_2\text{O}$	1253
" + $\text{NaI} + \text{H}_2\text{O}$	1263	" + $\text{NaCrO}_4 + \text{H}_2\text{O}$	1257
" + $\text{NaIO}_3 + \text{H}_2\text{O}$	1270	" + $\text{NaH}_2\text{PO}_4 + \text{H}_2\text{O}$	1286
" + $\text{Pb}(\text{NO}_3)_2 + \text{H}_2\text{O}$	1401, 1403	" + NaF	1260
$\text{NaOH} + \text{NaBr}$	1163	" + " + H_2O	1259
" + " + H_2O	1156-7	" + $\text{Na}_4\text{Fe}(\text{CN})_6 + \text{H}_2\text{O}$	1191
" + $\text{NaCN} + \text{H}_2\text{O}$	1190	" + $\text{NaI} + \text{H}_2\text{O}$	1264
" + $\text{Na}_2\text{CO}_3 + \text{H}_2\text{O}$	1207-8	" + $\text{NaIO}_3 + \text{H}_2\text{O}$	1271
" + NaCl	1249	" + $\text{NaNO}_3 + \text{H}_2\text{O}$	1279
" + " + H_2O	1232	" + $\text{NaOH} + \text{H}_2\text{O}$	1285
" + NaF	1260	" + $\text{Na}_2\text{S} + \text{H}_2\text{O}$	1295
" + $\text{Na}_2\text{SO}_4 + \text{H}_2\text{O}$	1307	" + $\text{Na}_2\text{SO}_3 + \text{H}_2\text{O}$	1298
$\text{Na}_3\text{PO}_4 + \text{NaCl} + \text{Na}_2\text{B}_2\text{O}_4 + \text{H}_2\text{O}$	1153	" + $\text{Nd}_2(\text{SO}_4)_3 + \text{H}_2\text{O}$	1334
$\text{Na}_3\text{PO}_4 + \text{NaF} \cdot 12\text{H}_2\text{O} + \text{H}_2\text{O}$	1280	" + PbSO_4	1416
$\text{Na}_3\text{PO}_4 + \text{Na}_2\text{SO}_4 + \text{H}_2\text{O}$	1308	$\text{Na}_2\text{S}_2\text{O}_3 + \text{Ag}_2\text{S}_2\text{O}_3 + \text{H}_2\text{O}$	77
$\text{Na}_4\text{P}_2\text{O}_7 + \text{NaCl}$	1249	" + $\text{NaNO}_3 + \text{H}_2\text{O}$	1280
$\text{Na}_2\text{SO}_4 + \text{Al}_2(\text{SO}_4)_3 + \text{H}_2\text{O}$	103	" + " + $\text{CaS}_2\text{O}_3 + \text{H}_2\text{O}$	344
" + BaSO_4	184	" + $\text{Na}_2\text{SO}_4 + \text{H}_2\text{O}$	1308
" + $\text{BeSO}_4 + \text{H}_2\text{O}$	195	$\text{Na}_2\text{S}_2\text{O}_6 + \text{BaS}_2\text{O}_4 + \text{H}_2\text{O}$	188

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(For locating results not found by searching the alphabetically arranged tables.)

$\text{Na}_2\text{SeO}_4 + \text{CaSeO}_4 + \text{H}_2\text{O}$	346	$\text{PbCl}_2 + \text{HgCl}_2$	639
" + $\text{MgSeO}_4 + \text{H}_2\text{O}$	996	" + LiCl	919
$\text{Na}_2\text{SiO}_3 + \text{CaSiO}_3$	347	" + " + H_2O	916
" + MgSiO_3	996	" + MgCl_2	969
" + NaF	1260	" + $\text{NH}_4\text{Cl} + \text{H}_2\text{O}$	1086-7
$\text{NbK}_2\text{F}_7 + \text{H}_2\text{O}$	809	" + $\text{NaCl} + \text{H}_2\text{O}$	1236
$\text{NdK}(\text{SO}_4)_2 + \text{H}_2\text{O}$	879	" + PbBr_2	1369
$\text{NdK}(\text{SeO}_4)_2 + \text{"}$	885	" + $\text{Pb}(\text{CH}_3\text{COO})_2 + \text{H}_2\text{O}$	1374
$2\text{Nd}(\text{NO}_3)_3 \cdot 3\text{Mg}(\text{NO}_3)_2 + \text{H}_2\text{O}$	981	$\text{PbCoNH}_4(\text{CN})_6 \cdot 3\text{H}_2\text{O}$	1063
$\text{NdNa}(\text{SeO}_4) + \text{H}_2\text{O}$	1323	$\text{PbF}_2 + \text{PbBr}_2$	1369
$\text{Ni}_3\text{Bi}_2(\text{NO}_3)_{12} + \text{H}_2\text{O}$	203	" + PbCl_2	1394
$\text{Ni}(\text{CN})_2 + \text{KCN} + \text{H}_2\text{O}$	719	$\text{PbI}_2 + \text{AgI}$	60
$\text{NiC}_2\text{O}_4 + \text{K}_2\text{C}_2\text{O}_4 + \text{H}_2\text{O}$	745	" + CdI_2	373
$\text{Ni}_2\text{Ce}(\text{NO}_3)_6 + \text{H}_2\text{O}$	389	" + KI	823
$\text{NiCl}_2 + \text{CdCl}_2 + \text{H}_2\text{O}$	363	" + " + H_2O	815-6
" + $\text{CoCl}_2 + \text{H}_2\text{O}$	413	" + $\text{LiI} + \text{H}_2\text{O}$	924
" + $\text{FeCl}_2 + \text{H}_2\text{O}$	530	" + PbBr_2	1369
" + $\text{LiCl} + \text{H}_2\text{O}$	915	" + PbCl_2	1394
" + $\text{NH}_4\text{Cl} + \text{H}_2\text{O}$	1085	" + " + H_2O	1391
$\text{NiCs}_2(\text{SO}_4)_2 + \text{H}_2\text{O}$	465	" + PbF_2	1397
$\text{NiF}_2 + \text{KF} + \text{H}_2\text{O}$	808	$\text{PbMoO}_4 + \text{Bi}_2(\text{MoO}_4)_3$	205
$\text{Ni}_3\text{Gd}(\text{NO}_3)_6 + \text{HNO}_3$	549	$\text{Pb}(\text{NO}_3)_2 + \text{AgNO}_3$	69
$\text{NiK}_2(\text{SO}_4)_2 + \text{H}_2\text{O}$	878	" + $\text{Ba}(\text{NO}_3)_2$	175
$\text{Ni}_3\text{La}(\text{NO}_3)_6 + \text{HNO}_3 + \text{H}_2\text{O}$	894	" + " + H_2O	173
$\text{Ni}_3\text{Nd}(\text{NO}_3)_6 + 24\text{H}_2\text{O}$	1332	" + $\text{Ca}(\text{NO}_3)_2$	309
$\text{Ni}_3\text{Pr}(\text{NO}_3)_6 + \text{H}_2\text{O}$	1421	" + $\text{CsNO}_3 + \text{H}_2\text{O}$	463
" + HNO_3	1421	" + KNO_3	850
$\text{NiRb}(\text{SO}_4)_2 + \text{H}_2\text{O}$	1440	" + " + H_2O	846-7
$\text{NiSO}_4 + \text{Al}_2(\text{SO}_4)_3 + \text{H}_2\text{O}$	103	" + NH_4NO_3	1115
" + $\text{CoSO}_4 + \text{H}_2\text{O}$	440	" + " + H_2O	1111
" + $\text{CuSO}_4 + \text{H}_2\text{O}$	506, 511-2, 515	$\text{PbO} + \text{Bi}_2\text{O}_3$	205
" + $(\text{NH}_4)_2\text{SO}_4 + \text{H}_2\text{O}$	1126	" + PbBr_2	1369
" + " + $\text{ZnSO}_4 + \text{H}_2\text{O}$	1126	" + PbCl_2	1394
" + $\text{Na}_2\text{SO}_4 + \text{H}_2\text{O}$	1309-10	" + PbF_2	1397
$\text{NiTi}_2(\text{SO}_4)_2 + \text{H}_2\text{O}$	1558	$\text{Pb}_3(\text{PO}_4)_2 + \text{PbCl}_2$	1394
$\text{PBr}_3 + \text{AlBr}_3$	83	" + PbF_2	1397
" + AsBr_3	105	" + PbO	1407
$\text{PI}_3 + \text{AsI}_3$	106	$\text{PbS} + \text{Ag}_2\text{S}$	73
$\text{PKF}_6 + \text{H}_2\text{O}$	809	" + Sb_2S_3	1463
$\text{P}_2\text{O}_5 + \text{PbO}$	1407	$\text{PbSO}_4 + \text{K}_2\text{SO}_4 + \text{H}_2\text{O}$	873
" + SbI_3	1483	$\text{PbSO}_4 \cdot (\text{NH}_4)_2\text{SO}_4 + \text{H}_2\text{O}$	1127
$\text{PdK}_2\text{Cl}_6 + \text{HCl} + \text{H}_2\text{O}$	783	$\text{PbSO}_4 + \text{PbO}$	1407
$\text{Pb} + \text{S}$	1455	$\text{Pb}_3(\text{VO}_4)_2 + \text{PbCl}_2$	1394
$\text{PbBr}_2 + \text{AgBr}$	11	" + PbF_2	1397
$\text{PbBr}_3 + \text{AlBr}_3$	83	" + PbO	1407
$\text{PbBr}_2 + \text{CsBr} + \text{H}_2\text{O}$	450	$\text{Pr}_2(\text{SO}_4)_3 + \text{Cs}_2\text{SO}_4 + \text{H}_2\text{O}$	464
" + HgBr_2	611	" + $\text{K}_2\text{SO}_4 + \text{H}_2\text{O}$	873
$\text{Pb}(\text{CH}_3\text{COO})_2 + \text{KCH}_3\text{COO} + \text{H}_2\text{O}$	700	" + $(\text{NH}_4)_2\text{SO}_4 + \text{H}_2\text{O}$	1127
" + $\text{NaCH}_3\text{COO} + \text{H}_2\text{O}$	1169	" + $\text{Na}_2\text{SO}_4 + \text{H}_2\text{O}$	1310
$\text{PbCl}_2 + \text{AgCl}$	48	$\text{PtCs}_2\text{Cl}_6 + \text{H}_2\text{O}$	456
" + $\text{BaCl}_2 + \text{H}_2\text{O}$	160	$\text{PtLi}_2(\text{CN})_4 + \text{H}_2\text{O}$	908
" + BeCl_2	190	" + $\text{K}_2\text{Pt}(\text{CN})_4 + \text{H}_2\text{O}$	908
" + CaCl_2	290	$\text{PtMg}(\text{CN})_4 + \text{H}_2\text{O}$	951
" + CdCl_2	364	$\text{Pt}(\text{NH}_4)_2\text{Br}_6 + \text{H}_2\text{O}$	1051
" + CoCl_2	417	$\text{Pt}(\text{NH}_4)_2\text{Cl}_6 + \text{H}_2\text{O}$	1086
" + CuCl	488	$\text{PtRb}_2\text{Cl}_6 + \text{H}_2\text{O}$	1434
" + FeCl_2	531	$\text{Rb}_2\text{Al}_2(\text{SO}_4)_4 + \text{H}_2\text{O}$	105

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(For locating results not found by searching the alphabetically arranged tables.)

RbAuCl ₄ + H ₂ O.....	116	S + Se.....	1486
RbBr.CdBr ₂ + H ₂ O.....	351	" + Tl ₂ S.....	1556
Rb ₂ CaFe(CN) ₆ + C ₂ H ₅ OH + H ₂ O.....	262	S ₂ Br ₂ + AsBr ₃	105
RbCl + AgI.....	60	" + PBr ₃	1363
" + BaCl ₂	162	SO ₂ + Br.....	213
" + CdCl ₂	364	" + CCl ₄	216
" + " + H ₂ O.....	361	" + Cl.....	399
" + CoCl ₂ + H ₂ O.....	413	" + HCl.....	578
" + CsCl.....	457	" + H ₂ S.....	598
" + CuCl.....	488	" + KI.....	823
" + HgCl ₂ + H ₂ O.....	627	" + NO ₂	1145
" + KBr.....	696	SO ₃ + PbO.....	1407
" + KCl.....	782	Sb + As.....	105
" + " + H ₂ O.....	773	" + I.....	678
" + " + MgCl ₂ + H ₂ O.....	766	" + S.....	1455
" + K ₂ SO ₄	879	SbBr ₃ + AlBr ₃	83
" + LiCl.....	919	" + AsBr ₃	105
" + PbCl ₂	1394	" + PBr ₃	1363
2RbCl.UO ₂ Cl ₂ + H ₂ O.....	1563	" + SbCl ₃	1482
Rh[Co(NH ₃) ₂ (NO ₂) ₂] ₄ + H ₂ O.....	427	SbCl ₃ + HgCl ₂	639
Rb ₃ Co(NO ₂) ₆ + H ₂ O.....	429	" + KCl.....	782
RbI + BiI ₃ + H ₂ O.....	201	" + NH ₄ Cl.....	1093
RbMnO ₄ + KMnO ₄ + H ₂ O.....	830	" + SbBr ₃	1473
RbNO ₃ + AgNO ₃	69	SbI ₃ + AsI ₃	106
" + KNO ₃	850	" + KI + H ₂ O.....	816
" + LiNO ₃	929	" + LiI + H ₂ O.....	924
" + RbCl.....	1434	" + NH ₄ I + H ₂ O.....	1099
RbNO ₃ .UO ₂ (NO ₃) ₂ + H ₂ O.....	1567	" + NaI + H ₂ O.....	1264
RbPtCl ₆ + H ₂ O.....	1424	" + PI ₃	1363
Rb ₂ SO ₄ + CaSO ₄	344	" + SbCl ₃	1482
" + CdSO ₄ + H ₂ O.....	384	SbK ₃ S ₄ + H ₂ O.....	856-7
" + CoSO ₄ + H ₂ O.....	441	SbLi ₃ S ₄ + H ₂ O.....	931
" + K ₂ SO ₄	879	" + C ₂ H ₅ OH + H ₂ O.....	931
" + MnSO ₄ + H ₂ O.....	1011	Sb(NH ₄) ₃ S ₄ + H ₂ O.....	1120
" + Nd ₂ (SO ₄) ₃ + H ₂ O.....	1334	" + C ₂ H ₅ OH + H ₂ O.....	1120
" + NiSO ₄ + H ₂ O.....	1350	SbNa ₃ S ₄ + H ₂ O.....	1320
" + Pr ₂ (SO ₄) ₃ + H ₂ O.....	1422	" + C ₂ H ₅ OH + H ₂ O.....	1321
" + RbCl.....	1434	" + NaOH + H ₂ O.....	1320
ReCa ₂ Cl ₆ + HCl + H ₂ O.....	456	" + Na ₂ S ₂ O ₃ + H ₂ O.....	1321
ReK ₂ Cl ₆ + " + ".....	783	SbOKC ₄ H ₄ O ₆ + H ₂ O.....	708
[Rh(NH ₃) ₅ Br]Cl ₂ + H ₂ O.....	423	Sb ₂ S ₃ + PbS.....	1408
Rh ₂ Na ₆ (NO ₃) ₁₂ + H ₂ O.....	1275	Se + HgCl ₂	639
S + As.....	105	" + I.....	678
" + BaS.....	181	" + P.....	1363
" + Bi.....	199	" + S.....	1455
" + Br.....	214	" + Tl ₂ S.....	1556
" + Cl.....	399	SiCl ₄ + Cl.....	399
" + HgCl ₂	639	" + SO ₂	1465
" + I.....	678	" + SiCl ₄	1488
" + " + CCl ₄	674	SiK ₂ F ₆ + H ₂ O.....	810
" + " + C ₆ H ₆	674	SiMgF ₆ + H ₂ O.....	970-1
" + " + CS ₂	674	SiMnF ₃	1003
" + K ₂ S.....	856	Si(NH ₄) ₂ F ₆ + H ₂ O.....	1098
" + Li ₂ S.....	931	SiNaF ₆ + H ₂ O.....	1261
" + NH ₃	1042	" + Na ₂ SO ₄ + H ₂ O.....	1261
" + P.....	1363	SiO ₂ + PbO.....	1407
" + Sb.....	1468	SiS ₂ + Ag ₂ O.....	73

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(For locating results not found by searching the alphabetically arranged tables.)

$\text{SiS}_2 + \text{PbS} \dots\dots\dots$	1408	$\text{SrSO}_4 + \text{Li}_2\text{SO}_4 \dots\dots\dots$	933
$\text{Sm}_2(\text{SO}_4)_3 + \text{Na}_2\text{SO}_4 + \text{H}_2\text{O} \dots\dots\dots$	1310	$\text{SrSO}_4 \cdot (\text{NH}_4)_2\text{SO}_4 + \text{H}_2\text{O} \dots\dots\dots$	1127
$\text{Sn} + \text{I} \dots\dots\dots$	678	$\text{TaK}_2\text{F}_7 + \text{HF} + \text{H}_2\text{O} \dots\dots\dots$	811
" + S.	1455	$\text{Te} + \text{Cl} \dots\dots\dots$	399
$\text{SnBr}_2 + \text{AlBr}_3 \dots\dots\dots$	83	" + I.	678
$\text{SnBr}_4 + \text{PBr}_3 \dots\dots\dots$	1363	" + S.	1455
" + $\text{SbBr}_3 \dots\dots\dots$	1473	" + Se.	1486
" + $\text{SO}_2 \dots\dots\dots$	1465	" + $\text{Ti}_2\text{S} \dots\dots\dots$	1556
$\text{SnCl}_2 + \text{CaCl}_2 \dots\dots\dots$	290	$\text{TeCs}_2\text{Cl}_6 + \text{HCl} + \text{H}_2\text{O} \dots\dots\dots$	456
" + $\text{CdCl}_2 \dots\dots\dots$	364	$\text{Te}_2\text{Cr}_7(\text{SO}_4)_4 + \text{H}_2\text{O} \dots\dots\dots$	449
" + $\text{Cl} \dots\dots\dots$	399	$\text{TeRb}_2\text{Cl}_6 + \text{HCl} + \text{H}_2\text{O} \dots\dots\dots$	1439
" + $\text{CoCl}_2 \dots\dots\dots$	417	$\text{Th}(\text{C}_2\text{O}_4)_2 + (\text{NH}_4)_2\text{C}_2\text{O}_4 + \text{H}_2\text{O} \dots\dots\dots$	1077
" + $\text{CuCl} \dots\dots\dots$	488	" + $\text{Na}_2\text{C}_2\text{O}_4 + \text{H}_2\text{O} \dots\dots\dots$	1216
" + $\text{KCl} + \text{H}_2\text{O} \dots\dots\dots$	773	$\text{ThCl}_4 + \text{CoCl}_2 + \text{H}_2\text{O} \dots\dots\dots$	414
" + $\text{FeCl}_2 \dots\dots\dots$	531	$\text{ThK}_2\text{F}_6 + \text{H}_2\text{O} \dots\dots\dots$	811
" + $\text{LiCl} \dots\dots\dots$	919	$\text{Th}(\text{SO}_4)_2 + \text{MnSO}_4 + \text{H}_2\text{O} \dots\dots\dots$	1011
" + $\text{MgCl}_2 \dots\dots\dots$	969	" + $(\text{NH}_4)_2\text{SO}_4 + \text{H}_2\text{O} \dots\dots\dots$	1127
$\text{SnCl}_3 + \text{PCl}_3 \dots\dots\dots$	1363	$\text{TiBr}_4 + \text{SO}_2 \dots\dots\dots$	1465
$\text{SnCl}_2 + \text{PbCl}_2 \dots\dots\dots$	1394	$\text{TiCl}_4 + \text{Br} \dots\dots\dots$	214
" + $\text{SbCl}_3 \dots\dots\dots$	1483	" + $\text{CCl}_4 \dots\dots\dots$	216
" + $\text{SO}_2 \dots\dots\dots$	1465	" + $\text{Cl} \dots\dots\dots$	399
$\text{SnI}_4 + \text{AsI}_3 \dots\dots\dots$	106	" + $\text{SnCl}_2 \dots\dots\dots$	1492
$\text{SnI}_2 + \text{SO}_2 \dots\dots\dots$	1465	$\text{TiK}_2\text{F}_6 + \text{H}_2\text{O} \dots\dots\dots$	811
" + $\text{SnCl}_2 \dots\dots\dots$	1490	$\text{TiLi}_2\text{F}_6 + \text{C}_2\text{H}_5\text{OH} \dots\dots\dots$	923
$\text{SnKBr}_3 + \text{H}_2\text{O} \dots\dots\dots$	696	$\text{Ti}(\text{NH}_4)_2\text{F}_6 + \text{H}_2\text{O} \dots\dots\dots$	1094
$\text{SnKCl}_3 + \text{H}_2\text{O} \dots\dots\dots$	783	$\text{TiNa}_2\text{F}_6 + \text{H}_2\text{O} \dots\dots\dots$	1261
$\text{SnNH}_4\text{Br}_3 + \text{H}_2\text{O} \dots\dots\dots$	1052	$\text{Ti} + \text{Br} \dots\dots\dots$	214
$\text{SnNH}_4\text{Cl}_3 + \text{H}_2\text{O} \dots\dots\dots$	1085	" + I.	678
$\text{SnS} + \text{Sb}_2\text{S}_3 \dots\dots\dots$	1483	" + P.	1363
$\text{SrBr}_2 + \text{KBr} \dots\dots\dots$	696	$\text{Ti}_2\text{Al}_2(\text{SO}_4)_4 + \text{H}_2\text{O} \dots\dots\dots$	105
" + $\text{LiBr} \dots\dots\dots$	900	" + $\text{K}_2\text{Al}_2(\text{SO}_4)_4 + \text{H}_2\text{O} \dots\dots\dots$	100
" + $\text{NaBr} \dots\dots\dots$	1163	$\text{TiBr} + \text{AlBr}_3 \dots\dots\dots$	83
$\text{SrCO}_3 + \text{NaCl} \dots\dots\dots$	1249	" + $\text{KBr} \dots\dots\dots$	696
$\text{SrCl}_2 + \text{As}_2\text{O}_3 + \text{H}_2\text{O} \dots\dots\dots$	109	" + $\text{KNO}_3 \dots\dots\dots$	850
" + $\text{BaCl}_2 \dots\dots\dots$	162	$\text{TiCN} + \text{KCN} + \text{H}_2\text{O} \dots\dots\dots$	715
" + $\text{BaO} \dots\dots\dots$	179	$\text{TiCl} + \text{AgCl} \dots\dots\dots$	48
" + $\text{CaCl}_2 \dots\dots\dots$	290	" + $\text{BaCl}_2 \dots\dots\dots$	162
" + $\text{CdCl}_2 \dots\dots\dots$	364	" + $\text{BeCl}_2 \dots\dots\dots$	190
" + $\text{CoCl}_2 \dots\dots\dots$	417	" + $\text{CaCl}_2 \dots\dots\dots$	290
" + " + $\text{H}_2\text{O} \dots\dots\dots$	415	" + $\text{CdCl}_2 \dots\dots\dots$	364
" + $\text{FeCl}_2 \dots\dots\dots$	531	" + $\text{CsCl} \dots\dots\dots$	457
" + $\text{HgCl}_2 + \text{H}_2\text{O} \dots\dots\dots$	628	" + " + $\text{H}_2\text{O} \dots\dots\dots$	456
" + $\text{KCl} \dots\dots\dots$	782	" + $\text{CuCl} \dots\dots\dots$	488
" + $\text{LiCl} \dots\dots\dots$	919	" + $\text{FeCl}_3 \dots\dots\dots$	531
" + $\text{MgCl}_2 \dots\dots\dots$	969	" + $\text{HgCl}_2 \dots\dots\dots$	639
" + $\text{NaCl} \dots\dots\dots$	1249	" + $\text{KCl} \dots\dots\dots$	782
" + $\text{PbCl}_2 \dots\dots\dots$	1394	" + $\text{LiCl} \dots\dots\dots$	919
" + $\text{RbCl} \dots\dots\dots$	1434	" + $\text{MgCl}_2 \dots\dots\dots$	969
$\text{Sr}(\text{NO}_3)_2 + \text{Ba}(\text{NO}_3)_2 \dots\dots\dots$	175	" + $\text{NaCl} \dots\dots\dots$	1249
" + $\text{Ca}(\text{NO}_3)_2 \dots\dots\dots$	309	" + $\text{PbCl}_2 \dots\dots\dots$	1394
" + $\text{KNO}_3 \dots\dots\dots$	850	" + $\text{RbCl} \dots\dots\dots$	1433
" + " + $\text{H}_2\text{O} \dots\dots\dots$	847	" + $\text{SiCl}_4 \dots\dots\dots$	1488
" + $\text{Pb}(\text{NO}_3)_2 + \text{H}_2\text{O} \dots\dots\dots$	1403	" + $\text{SrCl}_2 \dots\dots\dots$	1511
" + $\text{SrCl}_2 + \text{H}_2\text{O} \dots\dots\dots$	1510	$\text{TiCo}(\text{NH}_3)_2(\text{NO}_2)_4 + \text{H}_2\text{O} \dots\dots\dots$	422
$\text{SrO} + \text{CaCl}_2 \dots\dots\dots$	290	$\text{TiCsCl}_4 + \text{H}_2\text{O} \dots\dots\dots$	456
$\text{Sr}(\text{SH})_2 + \text{Sr}(\text{OH})_2 + \text{H}_2\text{O} \dots\dots\dots$	1518	$\text{TiNO}_3 + \text{AgNO}_3 \dots\dots\dots$	69
$\text{SrSO}_4 + \text{K}_2\text{SO}_4 \dots\dots\dots$	879	" + $\text{CdBr}_2 \dots\dots\dots$	352

CROSS REFERENCE INDEX

(For locating results not found by searching the alphabetically arranged tables.)

TlNO ₃ + HgBr.....	611	Zn ₃ [Ce(NO ₃) ₆] ₂ + H ₂ O.....	389
" + HgI ₂	648	ZnCl ₂ + BaCl ₂	162
" + KBr.....	696	" + BeCl ₂	190
" + KNO ₃	850	" + CaCl ₂	290
" + " + H ₂ O.....	847	" + CdCl ₂	364
" + LiNO ₃	929	" + CoCl ₂	417
" + Ti ₂ CO ₃	1543	" + " + H ₂ O.....	414
Tl ₂ PtCl ₆ + H ₂ O.....	1424	" + CuCl.....	488
Tl ₂ Rb ₂ Cl ₆ + H ₂ O.....	1434	" + FeCl ₃	531
Tl ₂ S + Ag ₂ S.....	73	" + MgCl ₂	969
" + PbS.....	1408	" + NH ₄ Cl.....	1093
Tl ₂ SO ₄ + CdSO ₄ + H ₂ O.....	385	" + " + H ₂ O.....	1088
" + Ce ₂ (SO ₄) ₃ + H ₂ O.....	395	" + PbCl ₂	1394
" + CoSO ₄ + H ₂ O.....	441	" + SrCl ₂	1511
" + HgBr ₂	611	" + TiCl + H ₂ O.....	1549
" + HgCl ₂	639	ZnCs ₂ (SO ₄) ₂ + H ₂ O.....	465
" + HgI ₂	648	ZnF ₃ + NaF.....	1260
" + La ₂ (SO ₄) ₃ + H ₂ O.....	896	Zn[Gd(NO ₃) ₆] ₂ + HNO ₃	549
" + MgSO ₄ + H ₂ O.....	992	ZnHg(CNS) ₄ + NH ₄ Cl + H ₂ O.....	619
" + MnSO ₄ + H ₂ O.....	1012	ZnK ₂ (SO ₄) ₂ + H ₂ O.....	878-9
" + Na ₂ (SO ₄) ₃ + H ₂ O.....	1335	ZnK ₂ (SO ₄) ₂ + FeK ₂ (SO ₄) ₂ + H ₂ O.....	544
" + P ₂ (SO ₄) ₃ + H ₂ O.....	1422	ZnKV ₅ O ₁₄ + H ₂ O.....	885
UO ₂ CO ₃ ·2K ₂ CO ₃ + H ₂ O.....	740	Zn[La(NO ₃) ₆] ₂ + HNO ₃ + H ₂ O.....	894
UO ₂ CO ₃ ·2(NH ₄) ₂ CO ₃ + H ₂ O.....	1075	ZnNH ₄ PO ₄ + H ₂ O.....	1119
UO ₂ C ₂ O ₄ + BaC ₂ O ₄ + H ₂ O.....	154	Zn[Nd(NO ₃) ₆] ₂ + H ₂ O.....	1332
" + CaC ₂ O ₄ + H ₂ O.....	279	Zn[Pr(NO ₃) ₆] ₂ + H ₂ O.....	1421
" + Na ₂ C ₂ O ₄ + H ₂ O.....	1215	" + HNO ₃	1421
" + SrC ₂ O ₄ + H ₂ O.....	1507	ZnRb ₂ (SO ₄) ₂ + H ₂ O.....	1440
UO ₂ (NO ₃) ₂ + KNO ₃ + H ₂ O.....	847	ZnS + Ag ₂ S.....	73
" + NH ₄ NO ₃ + H ₂ O.....	1111	" + PbS.....	1408
" + " + HNO ₃ + H ₂ O.....	1112	ZnSO ₄ + BeSO ₄ + H ₂ O.....	198
" + NaNO ₃ + H ₂ O.....	1281	" + CuSO ₄ + H ₂ O.....	505-6, 511-2, 515
" + Th(NO ₃) ₂ + (C ₂ H ₅) ₂ O.....	1533	" + " + H ₂ O.....	600
UO ₂ SO ₄ + K ₂ SO ₄ + H ₂ O.....	874	" + " + H ₂ O.....	873-4
" + (NH ₄) ₂ SO ₄ + H ₂ O.....	1128	" + MnSO ₄ + H ₂ O.....	1012
V ₂ Cs ₂ (SO ₄) ₄ + H ₂ O.....	465	" + (NH ₄) ₂ SO ₄ + H ₂ O.....	1128-9
V ₂ (NH ₄) ₂ (SO ₄) ₄ + H ₂ O.....	1128	" + " + CuSO ₄ + H ₂ O.....	513
V ₂ O ₅ + PbO.....	1407	" + " + NiSO ₄ + H ₂ O.....	1126
VTl(SO ₄) ₂ + H ₂ O.....	1559	" + Na ₂ SO ₄ + H ₂ O.....	1311-2
WO ₃ + PbO.....	1407	" + Ti ₂ SO ₄ + H ₂ O.....	1559
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Zn ₃ Bi ₂ (NO ₃) ₁₂ + H ₂ O.....	203	ZnTi ₂ (SO ₄) ₂ + H ₂ O.....	1558
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" + " + H ₂ O.....	720	" + K ₂ C ₂ O ₄ + H ₂ O.....	746
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ZnC ₂ O ₄ + K ₂ C ₂ O ₄ + H ₂ O.....	745-6	" + (NH ₄) ₂ C ₂ O ₄ + H ₂ O.....	1077
" + (NH ₄) ₂ C ₂ O ₄ + H ₂ O.....	1076	" + Na ₂ C ₂ O ₄ + H ₂ O.....	1217
" + Na ₂ C ₂ O ₄ + H ₂ O.....	1216	" + RbC ₂ O ₄ + H ₂ O.....	1433